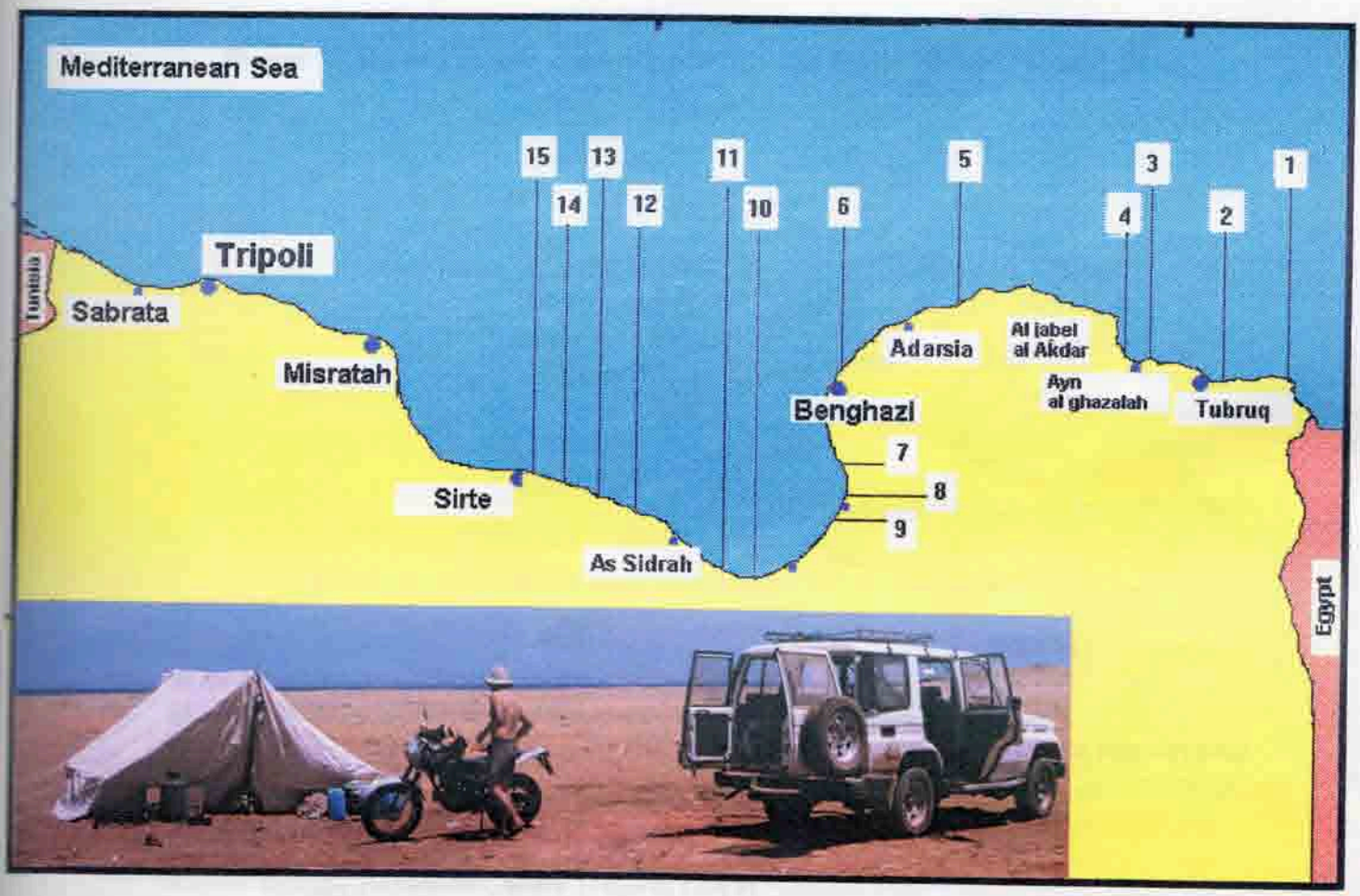
UNEP

UNITED NATIONS ENVIRONMENT PROGRAMME
MEDITERRANEAN ACTION PLAN
Specially Protected Areas

MARINE TURTLE NESTING ACTIVITY ASSESSMENT ON LIBYAN COASTS

Phase 1: survey of the coasts between the Egyptian border and Sirte.



Luc LAURENT
Mohamed N. BRADAI
Dau A. HADOUD
Hisham M. EL GOMATI

July 1995

RAC/SPA - 15 rue Ali Ibn Abi Taleb, Cité Jardins 1082 Tunis
Tel: (216 1) 795 760 - Fax: (216 1) 797 349

CONTENTS

Summary

A sea turtle survey in Libya was carried out from 16 June to 7 July 1995. It was organized by the Regional Activity Centre for Specially Protected Areas (RAC/SPA-MAP-UNEP)) and funded by, in alphabetical order, the Marine Biology Research Centre (Tajura, Libya), the Mediterranean Association to Save the Sea Turtles (Medasset), the Technical Centre for Environment Protection (Tripoli, Libya), the RAC/SPA and the World Wide Fund For Nature (WWF International Mediterranean Programme). This sea turtle survey had 3 objectives: (1) census loggerhead and possibly green turtle nesting activity, by looking for nesting signs during beach surveys, (2) measure nesting densities and estimate a mean annual number of loggerhead nests laid in Libya, (3) record threats linked to fisheries and other anthropic factors.

Libya has a 1,970 km coastline in the southern-most part of the Mediterranean, corresponding to 1,144 km of sandy beaches. Our sea turtle nesting investigation was focused on the coastal zone between the Egyptian border and Sirte, 1,195 km in length and containing 65% of the total Libyan sandy beaches. Fifteen coastal areas were surveyed with 50 beaches and beach portions prospected, totalling 141.65 km. The beaches were prospected one time (except double prospectings on 2 beaches) by walking and/or motorbike. Eleven loggerhead *Caretta caretta* nesting females were observed (mean size 78.05 cm SCCL, SD=4.01, range: 71-86.3) and all the 342 crawl tracks recorded were identified as belonging to this species. Nesting of the green turtle *Chelonia mydas* in Libya is thus most improbable. Loggerhead nesting activity was spread over the whole coastal zone. Densities of total crawl tracks observed on beaches, measured during single prospectings, varied from 0 to 5.8 crawl tracks/km, and that of total nests from 0 to 3.8 nests/km. Libya has large nesting

areas such as Sultan, Ras el Aweija, Shut El Badine and Kouf National Park, which now can be considered as major Mediterranean sites. By extrapolating in space and in time the number of nesting crawl tracks recorded during single prospectings to the whole Libyan sandy coast, the mean annual number of loggerhead nests laid in this country is estimated to be 9,000. It is now believed that Libya has the largest loggerhead colony in the Mediterranean, corresponding probably to more than 60% of the loggerhead nesting activity in this sea. The first estimate of the current size of the whole Mediterranean nesting loggerhead population is now available, and is of great value for demographic modeling and population dynamics analysis oriented towards conservation goals. This population may constitute the third largest loggerhead population in the world after those of Oman and the United States. As in other Mediterranean countries (except Zakynthos island in Greece), nest predation in Libya is high and 44.8% of the total nests detected during single prospectings were predated by carnivores and sand crabs. Two nesting females were found killed by carnivores, probably jackals, confirming previous observations by Schleich (1987) of loggerhead female predation in Libya.

In Libya the catches of sea turtles (local names: Fakrouna, Tersa) are recent and, compared to other Mediterranean countries, relatively low. In addition, unlike Egypt and Tunisia (before 1990), no commercial use for marine turtles in Libya is evident. However, the impact from a population dynamics point of view is probably not negligible, because these catches, in this country of high nesting activity, involve adult individuals and it must be borne in mind that the fishing sector will develop considerably in coming years. Human density on the Libyan coastal fringe is low and tourism is non-existent. Apart from the areas around towns and industrial centres, most of the Libyan coast is still protected from anthropic deterioration and remains very wild. This situation for a large expanse of sandy coast seems unique in the Mediterranean, but it risks being totally changed since a Ministry of Tourism was formed in July 1995.

Recommendations

The loggerhead turtle nesting sites discovered in Libya turned out to be among the main nesting areas for the species in the Mediterranean; this heritage should be protected. The exceptional situation in the Mediterranean could facilitate the creation of a Libyan conservation strategy for this species; most of the coast is completely unspoiled by human development, fishing is only slightly developed and tourism practically non-existent. Here Libya can become a model for conservation, management and planning of the large diversity of its coastal fringe. The protection of nesting beaches should be taken into account in all future planning for the coastal areas.

Educational programme on sea turtle protection for the fishing world

Advantage should be taken of the present low level development in fishing; a really serious policy of informing and awareness-raising on protection of sea turtles must be established in order to anticipate and avoid the adverse consequences of future sea turtle and fishery interactions. With assistance from different sources, this policy should operate at all levels in the fishing sector: fishing schools, administration, markets, ports, boats, etc. Libya can serve as a model for a later widening of such a pilot scheme throughout the whole Mediterranean.

Knowledge of how certain fishing devices are being used, and how they interact with sea turtles, would allow direction to be given to future actions. Investigations on interaction of sea turtles with trawling, gillnets and fishing with dynamite, are indispensable.

Censusing nesting activities along the whole coast

It is essential to continue censusing nesting activities on the whole Libyan coast in order to acquire, as rapidly as possible, detailed mapping of nesting beaches and a more accurate estimate of the mean annual number of loggerhead nests in Libya.

Acknowledgements

This survey was made possible by the support of:

Mr Abdulgader A. ABUFAYED Director of the Technical Centre for Environment Protection (TCEP,Tripoli)

Mr Dawid Saïd DAWID Director of the Marine Biology Research Centre of Tajura

For their valuable help and collaboration during the survey we wish to thank:

Mr Omar GHARIANI Technical Centre for Environment Protection (Tripoli)

Mr Salem AHMED TARHONI Driver Marine Biology Research Centre of Tajura

The Libyan Aquaculture Project, in particular:
Mr Ahmed EL GOUD Aquaculture Project Manager
Mr Ali ABDULLAH Director of the Aquaculture Project at Ayn el Ghazalah
and Mr Rajab ASHOUBAKI Aquaculture Project at Ayn el Ghazalah

The Zueitina Oil Company, in particular:
Mr AREFEI directeur de Zueitina Oil Company
Mr Mohamed BORGEA Terminal Supreintendant
Mr Saleh ABDOU EL GALI ALGARASE security Supervisor
Mr Mohamed DEHDAH ALI

Mr Shaban EL HABONI and his wife for their hospitality

Mr Abdou EL GAFAR

Ministry of the Sea and the fisheries
Mr Shouhoub DORHANI
Mr Mohamed DAU

Mr Ali SHWAELL fisherman at Harawa

Mr Eric REYNOLDS FAO Libfish Project Manager

1 INTRODUCTION

Two sea turtle species, the green turtle *Chelonia mydas* and the loggerhead *Caretta caretta*, nest in the Mediterranean and are represented by populations genetically distinct from those in the Atlantic (Bowen *et al.* 1992, Laurent *et al.* 1993, Bowen *et al.* 1993). Whatever the different scenarios suggested by the Blue Plan for the future development of the Mediterranean countries (UNEP 1988), human pressures on these two specific sea turtle populations are likely to increase in coming years. Therefore, they are potentially endangered populations; the situation is more dramatic for the green turtle population, whose nesting area is more restricted. Other than pollution (Gramentz 1988) coastal urbanisation and tourism, human threats to sea turtles involve captures by fisheries (Di Palma 1978, Argano 1979, Argano & Baldari 1983, De Metrio *et al.* 1983, Delaugerre 1987, Caminas 1988, De Metrio & Megalofonou 1988, Cocco *et al.* 1988, Gramentz 1989, Laurent *et al.* 1990, Laurent 1990, 1991, Mas & Garcia 1990, Raga & Salinas 1990, Aguilar *et al.* 1992, Argano *et al.* 1992, Bradai 1992, 1995a, Margaritoulis *et al.* 1992, Panou *et al.* 1992, Laurent & Lescure 1994, Lazar & Tvrtkovic 1995). These captures are usually incidental to ordinary fishing but can have an economic interest when numerous *i.e.* when they are counted in the fishery statistics, as in Palestine, Syria and Turkey at the beginning of the century (Hornell 1935, Sella 1982, Geldiay *et al.* 1982), in Malta up to the sixties (Gramentz 1989), in Tunisia up to 1989 (Laurent *et al.* 1990) and at present in Egypt (FAO 1995). Mediterranean fishing activity exerts on sea turtle populations an enduring high pressure responsible every year for the death of thousands of individuals of all sizes and represents the highest anthropic mortality factor known in this sea.

Safeguarding these marine turtle populations thus requires a coherent conservation strategy based on a rigorous analysis of the above threats, in order to propose, find

funding and acceptance on solid and well reasoned bases for the most effective actions on a Mediterranean scale. For this it is vital (1) to determine in every country of the region the reproductive status of marine turtles and record the various threats on them, and (2) to dispose of tools, such as demographic models, for analysing these threats.

The status of marine turtles was first studied on the eastern and northern shores of the East Mediterranean basin, in Israel (Sella *in* Anon 1967, Sella 1980, 1982), Cyprus (Demetropoulos 1971), Turkey (Geldiay 1978, Geldiay *et al.* 1982), Italy (Argano 1979) and Greece (Margaritoulis 1980, 1981, Marinos 1981, Sutherland 1984). These researches revealed major nesting sites in Greece and Turkey, and allowed the first conservation actions to be started. Conversely, for the African coasts as a whole, the status of marine turtles long remained unknown. The first studies on marine turtles in North Africa are recent and mainly sponsored by RAC/SPA (MAP-UNEP). They began in Tunisia (Laurent *et al.* 1990, Bradai 1992, 1993, 1995ab, Laurent & Lescure 1994), then in Algeria and Morocco (Laurent 1990) and lastly in Egypt (Kasparek 1993). So Libya with its 1,970 km of coastline in the eastern basin and in the southern-most part of this sea, was the only remaining Mediterranean country not systematically studied. Only rare data on marine turtles was available there. Loggerhead nesting beaches were discovered in the Kouf National Park (Herbert 1979, Armsby 1980, Schleich 1987), nesting tracks were observed in the Gulf of Sirte and on the eastern coasts (Meininger *et al.* 1994a, Hadoud & Assigier 1995) and two loggerhead turtles that had been tagged in other countries were recaptured in Libya (Margaritoulis 1988a, Aguilar *et al.* 1993). But no data on the possible nesting of green turtles was available. The lack of data on the reproductive status of sea turtles along this long coastline restricted any attempt at a demographic synthesis on a Mediterranean scale. However, judged by its long sandy coasts in the

southern part of the eastern basin still in a natural state, its low fishing activity and high loggerhead nesting activity discovered in the Kouf National Park (Schleich 1987), Libya was concluded to have the largest loggerhead colony in the Mediterranean (Laurent 1993).

The field survey organised in Libya in summer 1995 had three main objectives: (1) census loggerhead and possibly green turtle nesting activity, by looking for nesting signs during beach prospecting, (2) measure nesting densities on these beach samples and calculate a first estimate of the mean number of loggerhead nests laid each year in Libya, (3) record threats linked to fisheries and other anthropic factors.

2 MATERIALS AND METHODS

2-1 General data on Libya

2-1-1 The coastline

Libya has a 1,970 km coastline in the southern-most part of the Mediterranean basin. The Libyan coast is the longest of all the African countries and the sixth longest in the Mediterranean. Three-quarters of the coast is low-lying and corresponds to the maritime fringe of the Libyan desert; the rest is mountainous, being on the slopes of the Jebel Akhdar (Green Mountain) in the east (Map 1). The sandy coast, mesured on 1/50,000 maps with the help of a curvimetre, is 1,144 km long and represents 64% of the coastline. It is made up of 3 large sandy areas: between the Tunisian border and Sabratah (86 km), between Misratah and Sirte (196_ km) and, especially, between As Sidrah and Adarsia (Tolmieta) (440 km), and many beaches demarcated by little rocky plateaux or hemmed in by the banks of the Jebel Akhdar (Map 1). The continental shelf covers around 55,000 km² and the 200 m isobath has a mean distance from the coasts of 30 km. It is particularly wide in the Gulf of Sirte, especially in the west, which is an extension of the Gulf of Gabès.

The Libyan coast has 4 lagoons : Farwa, Ayn Zayanah, Kalige Bomba and Ayn al Ghazalah, described in the work of Kerambrun (1986), Lemoalle & Saad (1987), Hadoud (1992) and Reynolds *et al.* (1995). There are also several river estuaries, some of which were studied from an ornithological point of view by Meininger *et al.* (1994a). The avifauna of the coastal fringe was studied by Bundy (1976), Meininger *et al.* (1994ab) and Hadoud & Zagouzi (*in press*). Data on herpetology were supplied by Schleich (1987).

Most Libyans (total of 4.4 million people in 1993) live in the coastal regions; the population density there, however, remains the lowest of all Mediterranean countries: 7 persons per km² (situation in 1985, UNEP 1988).

2-1-2 Marine fisheries

The fishing sector is still very little developed in Libya. Total catch for the Libyan coastline is low, estimated in 1991 at 7,700 tonnes, whereas it was 90,710 tonnes in Tunisia and 40,192 tonnes in Egypt (FAO 1993). In 1994, fishing production was 33,469 tonnes (General People's Committee of Halieutic Wealth).

Five main types of fishing occur in Libya: coastal fishing, *lampara* fishing, bottom trawling, tuna fishing with seiners and *tunaras* (Lamboeuf & Reynolds 1994, Reynolds *et al.* 1994).

Coastal fishing is mainly practiced in the east and west of the country, and occasionally in the Gulf of Sirte. Fishing gear used are trammel nets and gill nets, and bottom and drifting longlines. There are some 3,000 small craft of varying lengths.

Lampara fishing catches small pelagics such as sardines and mackerel by using boat lamps and seines. This occurs only on the west coast; 132 boats make up the fleet.

Bottom trawling is industrial *i.e.* the boats belong to the state or private companies. It is done in the west and in the Gulf of Sirte. There are 85 trawlers, but some are no longer operational (Lamboeuf & Reynolds 1994).

There are 5 tunaras belonging to the state, two are in use; fishing with dynamite occurs widely (Lamboeuf & Reynolds 1994, Reynolds *et al.* 1994)

2-1-3 Laws protecting marine turtles

2-1-3-1 International

Libya ratified the Convention for the Protection of the Mediterranean (the Barcelona Convention) on 31 January 1979, and the Protocol on Specially Protected Areas, on 6 June 1989. Libya is not Party to any of the following international conventions: CITES, Bonn or the African Convention.

2-1-3-2 National

Libyan law no. 14(1989) on the environment allows natural reserves and species to be protected; a specific order on the protection of marine turtles came into force in 1993.

2-2 Methodology

2-2-1 Beach survey

2-2-1-1 Date of the mission

The mission took place from Friday 16 June to Friday 7 July 1995. These dates were chosen in accordance with the loggerhead nesting period in the Mediterranean. The nesting period extends over 3 months from late May to late August. However, peak nesting occurs in late June in Turkey (Geldiay *et al.* 1982, Van Piggelen & Strijbosch 1993) and in Northern Cyprus (Godley & Broderick 1994, Broderick &

Godley 1995), but during mid-July in Greece (Margaritoulis 1987, 1988b, Sutherland 1984).

2-2-1-2 Beach sampling

Due to the great length of the Libyan coast and the short duration of the mission, the investigation concentrated on the coastal zone between the Egyptian border and Sirte, totalling 1,195 km of coastline and representing 67% of the total Libyan coast. In this zone, 15 coastal areas were prospected corresponding to 50 beaches and beach portions (Table 1, Map 1). The beaches were sampled according to the investigations already carried out in 1991/1992 on the eastern Libyan coasts (Hadoud & Assigier 1995) and taking into account the distance from our campsite and capacities of reaching them by our means of transport.

2-2-1-3 Beach prospecting method

The team was made up of 5, then 6, participants, transported by 4x4 car and Yamaha TW200 motorbike driven by L.L. These vehicles allowed us to travel quickly over large distances (6,000 km covered during the mission), to reach beaches that were not easily accessible and to transport camping gear.

The beaches were prospected by walking and/or motorbike. Geographical coordinates of the beaches were measured with a Global Positioning System instrument. Length of the prospected beach was measured by using the motorbike's kilometric meter, graduated in hundreds of meters, or roughly estimated as we prospected on foot and then measured more precisely on 1/50,000 maps on the basis of the coordinates of the two extremities.

We wanted to record nesting signs on the beach samples in order to locate nesting activity and estimate nest density along the Libyan coast. These two objectives

implied covering the coast in both space and time. Unfortunately, certain timetable demands linked to technical problems made us decide to favour the first and restrict the second. Therefore most of the beaches were prospected only one time except for double surveys in some beaches (Table 1).

2-2-1-4 Classifying nesting signs

Observed nesting signs were classified in one of the five following categories:

Crawl tracks:

UCT crawl track on the beach without any digging attempt; it generally forms a U on the beach.

FCT crawl track with one or more digging attempts but no egg deposition (false nesting attempt).

NCT nesting crawl track leading to a nest. This kind of crawl track has an area where the sand has been greatly disturbed and where digging and covering have occured. The presence of the nest is never 100% certain, and only observation of egg shells on the surface, in the case of a predated nest, or excavation of the eggs, can confirm this.

CT old crawl track for which no means of classification is available.

Nests:

N nest without crawl track, opened by a predator, and almost always with remains of shells on the surface.

2-2-1-5 Crawl track identification

Crawl tracks of the loggerhead turtle *Caretta caretta* are typically well under 1 meter in width and present alternating (asymmetrical) diagonal marks made by the front flippers. The area of egg deposition shows a small degree of associated sand disturbance.

Green turtle *Chelonia mydas* makes larger crawl tracks around 1 meter in width with symmetrical diagonal marks made by the front flippers. Nest areas show a large amount of sand disturbance and a deep depression is still evident after the female has left for the sea.

During this nesting survey we recorded the asymmetry or symmetry of the marks noted for all crawl tracks observed, and the width of the crawl tracks made by the deep marks of the front flippers as well as total track width for fresh crawl tracks. Furthermore, egg diameters and depths of nests were measured when nests were dug up for various reasons.

2-2-2 Estimate of mean annual number of loggerhead nests laid in Libya

Our method of estimate was based on sampling of both spatial and temporal nest distributions in Libya in 1995. The total length of the potential beaches for nesting in Libya (1,144 km) was sampled as described previously by prospecting 50 beaches or beach portions. The NCT recorded by these single prospectings represent the number of nests laid on each beach sample during a certain period of the nesting season. Lifetime of crawl tracks was estimated to be 3-4 days, according to meteorological and granulometric conditions (Sofer 1988). We extended this period to one week and assumed that any nest laid 7 days before a single prospecting would have a very low

probability of being recorded as a NCT. Therefore, the number of NCT observed during a single prospecting is an estimate of the total number of nests laid during a 7 day period. The number of nests laid during such a period depends on location in the temporal nesting distribution. Loggerhead nest distributions observed on Mediterranean beaches (Sutherland 1984, Margaritoulis 1987, 1988b, Broderick & Godley 1993, 1995, Erk'akan 1993, Godley & Broderick 1994) present three 4 week phases: a growth phase, a stable phase and a rapid decrease phase. Our survey between 19 June and 5 July 1995 (Table 1) corresponded to around 4 weeks of nesting, spread over the first phase (3 weeks) and the second phase (one week). Analysis of nesting distribution on a weekly basis indicates that the number of nests laid during each week of this nesting season portion represents on average 10.1% of the total nesting season at Kiparisia Bay (Margaritoulis 1988b) and respectively 9.4, 10.1 and 14% in Northern Cyprus (Broderick & Godley 1993, 1995, Godley & Broderick 1994), with a mean value of 11%. Finally, we estimated the mean annual number of nests laid in Libya by extrapolating the number of nesting crawl tracks recorded during single prospectings to the whole Libyan sandy coast for an entire Mediterranean temporal nest distribution, using the following equation:

$$\text{Mean annual nest number} = \frac{\text{Total NCT observed by single prospectings}}{\text{total km prospected}} \times 1{,}144\text{km} \times 1/0.11$$

2-2-3 Measuring size of sea turtles

Size of observed sea turtles (nesting females, dead turtles washed up on beaches and carapaces of turtles caught by fishermen) was determined according to the SCCL method, Standard Curve Carapace Length (Pritchard *et al.* 1983). The carapace length is measured from the precentral scute (nuchal scute) at carapace midline to the posterior margin of the postcentrals (last marginal scutes).

2-2-4 Tagging

All the nesting females observed were tagged on the trailing edge of one front flipper using blue plastic tags type plastic rototag with the RAC/SPA address marked on it. Blood samples were taken from these females using the method of Owens & Ruiz (1980). They will serve as DNA sources for a Mediterranean loggerhead population genetics study.

2-2-5 Sea turtle and fishery interactions

Inquiries to fishermen were made in various places accompagnied by interviews dealing with the fishing gear used, catches of sea turtles and utilisation of captured turtles.

3 RESULTS

3-1 Sea turtle species found in Libya

3-1-1 Loggerhead turtle *Caretta caretta*

A total of 342 crawl tracks of nesting females were recorded during beach prospecting. All presented an asymmetrical arrangement of the front flipper marks. The mean width of the crawl tracks left by the deep marks of the front flippers was 59.09 cm (SD= 4.9, range: 47-74, N= 196) and the mean total width of the crawl tracks was 79.09 cm (SD=6.94, range: 63-98, N=179). During the survey, 11 nesting females were observed; all were loggerhead turtles *Caretta caretta* (mean size 78.05 cm, SD=4.01, range: 71-86.3). The 4 nesting females observed at night on the beaches left crawl tracks whose two types of width were: 59/75 cm, 55/73 cm, 64/72 cm and 59/77 cm.

Egg excavations of some NCT were made. Mean clutch size was 95.21 (SD=15.4, range: 72-128, N=14). Mean egg size for recently laid eggs for 3 nests was 40.31 mm (SD=0.83, range: 39-42, N=27), 40.82 mm (SD=0.71, range: 39.5-42, N=50) and 39.89 mm (SD=0.97, range: 38-42, N=74). The upper depth of nests was on average 29.15 cm (SD=7,.93, range: 14-38, N=13) and the lower average depth of nests was 47.77 cm. (SD=4.72, range: 40-58, N=11).

All sea turtles washed up on the beach were loggerheads. A dead loggerhead found at sea and brought back to land by fishermen was also observed. The average size of these individuals was 63.69 cm (SD=7.02, range: 51-72, N=13).

All observed crawl tracks of nesting females were attributed to the loggerhead turtle. This conclusion is based on the asymmetrical arrangement of the marks and the width of the crawl tracks. The mean width of crawl tracks left by the marks of the flippers is significantly different ($P< 0.01$) from the mean width of the tracks of the green turtle observed in Northern Cyprus by Godley & Broderick (1992) (m=77 cm, SD=9.9, N=29), and no track observed had a total width greater than 1 meter. For a certain NCT, another parameter, which however does not constitute an absolute criterion for determination, confirms this identification. The mean size of eggs in each nest is significantly smaller (test t, $P <0.05$) than that of the single available value for the green turtle in the Mediterranean (m=43.9 mm, SD=0.7, range: 43-45, N=15, Gerosa *et al.* 1995). Finally, no track gave rise to any real ambiguity on identification of the species. Bearing in mind the fact that all our elements on sea turtle nesting activity concerned the loggerhead turtle, we supposed that all nests inventoried without crawl tracks (N) belong to this species.

3-1-2 Green turtle *Chelonia mydas*

None of the observed elements related to nesting activity can be attributed to the green turtle. Nesting of this species in Libya is thus most improbable. A similar result was obtained in Tunisia (Laurent *et al.* 1990) and along the western coasts of Egypt (Kasparek 1993). We can affirm that the Mediterranean green turtle nesting area is extremely restricted and limited to the south-east coast of Turkey, to Cyprus, Israel and perhaps the eastern coast of Egypt, where this species is caught in great numbers (Laurent *et al.* 1996).

Two carapaces of green turtle juveniles (length 29 and 29.3 cm) (Photo 9) were observed in the possession of people living near Ayn al Ghazalah in the east of the country (Map 1). These turtles had been caught alive in the Ayn al Ghazalah lagoon

in 1992. This data confirms the first observations of juveniles and of an adult specimen in Libya made in Ayn al Ghazalah in 1992 (Hadoud & Assigier 1995). The area of pelagic movement of the species, which already extended to the Tunisian coasts (Laurent *et al.* 1990), now logically includes Libya.

3-1-3 Leatherback turtle *Dermochelys coriacea*

During the survey, fishermen told us that very big turtles had been caught, but no reliable data was obtained. The only available information concerns former catches of two big individuals in *tonnaras*, one in 1927 in Benghazi, the other in 1928 in Tripoli (Capra 1949).

3-2 Nesting of the loggerhead turtle *Caretta caretta* along Libyan coasts

3-2-1 Description of nesting activity and surveyed coastal areas

Between the Egyptian border and Sirte, 15 coastal areas were surveyed; the total length of the 50 beach samples prospected was 141.65 km (Table 1). Nesting activity was spread over the whole zone (Table 1, Map 1). Observed crawl track density measuring during single prospectings varies from 0 to 5.8 crawl tracks/km, that of nests (NCT+N) from 0 to 3.8 nests/km (Table 1, Map 1). Prospecting conditions between areas were not identical (different prospecting dates, predation activity and track longevity linked to probably different meteorological and granulometric conditions), which theoretically rules out any comparison. However, these factors do not seem very important to us and we suspect a lower nesting activity along the more eastern coast of Libya between Tubruq and the Egyptian border. The situation in Zuwaytinah (coastal area 9) seems to us much more significant, since no crawl track

was observed along 35 km of coast, 15 km of which were surveyed twice (Table 1). Supplementary information is presented in the list of the 15 coastal areas ranked from east to west.

Ras Azzaz (coastal area 1)

An area west of Sawani al Mallahah, with numerous wide beaches demarcated by little rocky areas and very big sand dunes perpendicular to the coast. The beaches and entire coastal fringe are very wild (Photo 1) and no trace of human activity was observed.

El Ageila (2)

A coastal plain east of a big rocky area, used for agriculture. Some fields are situated on the edge of little sebkhas bordering on beach 9, which is 80 m wide and has no dune belt (Table 1). Coastal urbanisation was absent, but much plastic waste cluttered the beaches.

Ayn al Ghazalah (3)

An area north-east of Ayn al Ghazalah. Wild beaches covered with accumulated dead *Posidonia oceanica* leaves, plastic waste and tar. The small beach 11 was situated at the mouth of the Wadi Sahal oued, with a little wetland area behind it. Beach 12 Oum Ghigah, easily reached by car, is a bathing place. Small scale exploitation of the sand in the dunes of this beach was observed.

Oum el Frais (4)

Small, isolated and very wild beach situated along the sandy coast of the Bumba Gulf with big accumulations of dead *Posidonia* leaves. Two loggerhead nesting females were found dead on this beach, killed by predators while digging.

El Kouf National Park (5)

Beaches 20, 21, 22 and the eastern part of beach 23 (2.6 km) correspond to the area of the Kouf National Park described by Schleich (1987). On this coastal fringe grazing takes place. No other use of this land was observed.

North Benghazi (6)

A long beach, 300-500 m wide, situated 30 km north east of Benghazi and bordered by a road located 2 km from the coast. There is a stronger human presence in this coastal fringe, associated with little urbanised areas, agricultural activity and a power station to the south of beach 25. This is a recreational beach, and bathers' tents were observed, particularly in Ayn Ziana. In Dariana (beach 24) two fishermen huts (fishing landing sites) were noted.

Near one of the huts five loggerhead turtle carcasses were observed. These were the remains of nesting females caught at night for food. A sixth nesting female, this one alive, was held in captivity to pull young swimmers around. She was tagged (F3031, carapace length 79.5 cm) and then released. Fishermen said that catching nesting females is common practice; 20 individuals were killed in this way the previous year. Turtle eggs are also said to be eaten.

Shut El Badine (7)

Coastal fringe with a long narrow beach (30 to 50 m wide), sparsely populated. Limited agricultural activity has developed (Photo 2). A fishing landing site with 3 fishing boats and 2 parking areas for bathers' cars, were observed.

Sultan (east Zuwaytinah) (8)

This coastal fringe is also sparsely populated; an area behind the beach is used for agriculture. A parking area for cars of weekend bathers and campers was observed.

In this coastal area nesting activity is high. Double surveys of the beach North Sultan (beach 27, Table 1) revealed 21 nests (NCT) laid over 3 nights *i.e.* 7 nests/night and 0.875 nests/km/night. In addition two nocturnal surveys of a portion of this area were done on 29.06 with two nesting loggerhead turtles observed and tagged (F3011, 74.3 cm; F3021, 74.5 cm) and on 30.06 with two loggerhead turtles observed and tagged (F3001, 86.3 cm; F3051, 81.0 cm).

Zuwaytinah (9)

Zuwaytinah is a small village with a shelter for about twelve fishing boats equipped with outboard motors. To the south of the village, stretching over 5 km, there are oil installations which in an area for the treatment, stocking and loading of oil from a pipeline. To the south of this oil terminus, we found a section of sandy coast (beach 29, Table 1). This area is very wild with only 3 camps of fishermen using dynamite being inventoried over 35 km of sandy coast (Photo 3). Two diurnal prospectings were carried out and no crawl track was observed (Table 1).

El Aquaylah (10)

A small village one kilometre from the coast. This coastal fringe is sparsely populated with some pasturage (Photo 4).

Um Gharaniq (11)

A wild area with small beaches and little groups of rocks.

Ras el Aweija (12)

Another wild area with small beaches and groups of rocks.

Wadi el Ahmar (13)

A strip of coast, wild and sparsely populated, with small beaches and little groups of rocks.

Marsa Sultan (east Sirte) (14)

A beach west of a small fishing port.

East Sirte (15)

A coastal strip east of Sirte with large sandy areas where beaches are more or less demarcated (Photo 5).

3-2-2 Predation

3-2-2-1 Nest predation

The rate of nest predation is 43.7% for all 197 nests (NCT+N) detected and 44.8% for the nests (NCT+N) detected during single prospectings (Photo 7). The rates of predation for the detected NCT alone were respectively 30.8 and 30.3%. Nest predation was particularly common in the areas of Ras el Aweija (12), Sultlan (8) and Ayn al Ghazalah (3), where predation rates for all recorded nests were respectively 75, 72 and 68.2%. The predators involved are the fox *Vulpes vulpes*, the jackal *Canis aureus* and sometimes roaming dogs. Numerous opened nests showed the presence of holes made by the sand crab *Ocypode cursor*, a species observed on all prospected beaches.

3-2-2-2 Nesting female predation

On the beach of Oum el Frais (4), two nesting loggerhead turtles were found dead, killed by predators while digging the nest (Photo 8). Both showed that they had been attacked in the neck; they had large openings in their sides, and flesh and viscera had been eaten. There were no longer any tracks around the females to indicate the predators, but it could well have been the jackal *Canis aureus*, which is common in the region.

3-2-3 Estimate of the mean annual number of loggerhead nests laid in Libya

The total number of NCT recorded during single prospectings of 141.65 km of beach samples was 122 (Table 1), leading to an estimate of 8,956 nests laid in Libya in 1995.

3-3 Sea turtle and fishery interactions

Inquiries were conducted in the small ports of Zuwaytinah (Photo 10) and El Harawa, and on the beach of Driana. In these areas coastal fishing gear are used: bottom and drifting longlines, trammel nets and gillnets such as the shark large mesh net locally called *khannaga*, which is not always hauled daily. Fishermen mentioned incidental captures of sea turtles by these fishing gear, but the number they gave seems rather low. A fisherman at Zuwaytinah caught five dead turtles with his *khannaga* during the 1995 season, which stretches from February to May. The 2 green turtle carapaces observed came from individuals caught alive in *drinas* (fixed traps made up of series of nets supported by reeds and placed in shallow water to catch young fish intended for aquaculture).

Consumption of turtles by Libyan fishermen is probably low. Turtles are eaten for their flesh rather by Egyptian fishermen, who represent more than a quarter of fishermen in Libya (Reynolds *et al.* 1994). The 2 green turtles observed were consumed by Egyptians. On the beach of Driana, however, 25 nesting females killed for their flesh were eaten very probably by Libyan fishermen. During the survey 2 reports of the consumption of eggs were received.

4 DISCUSSION

4-1 The nesting loggerhead population of Libya

4-1-1 Nesting activity

Crawl track density was on average 2.16 per km for the 141.65 km prospected (Table 1). One can compare this result with those obtained with the same methodology in other African countries. In Morocco and Algeria, no crawl track was recorded during multiple prospectings of 97.9 km of beaches (Laurent 1990). In Tunisia the observed crawl track density was 0.014 (Laurent *et al.* 1990) and 0.16 tracks/km (Bradai 1993), and along the western coasts of Egypt the density was 0.039 tracks/km (Kasparek 1993) (Table 2). Libya is therefore the African country where observed nesting activity is the most important.

Nesting activity was spread over the whole zone investigated between the Egyptian border and Sirte. However, as in any country where nesting occurs, this activity is not uniform. The apparent low nesting activity along the most eastern coasts of Libya, between Tubruq and the Egyptian border, may be compared to the situation observed further east along the western Egyptian coasts, where observed nesting activity was very low (Kasparek 1993). In the Egyptian sea, turtles are caught in large numbers by fisheries (Laurent *et al.* 1996) and some females that nest along the most eastern coasts of Libya are perhaps incidentally captured in Egyptian waters. In the area of Zuwaytinah (coastal area 9), no evident element can explain the probable very low nesting activity.

In terms of observed nest density (NCT+N), coastal areas of Libya contain large nesting sites, such as Sultan, Ras el Aweija, Shut El Badine and Kouf National Park.

The North Sultan site had an observed nest density of 5.12 nests/km/season measured during only 2 prospectings (beach 27, Table 1) and Schleich (1987) has established by multiple surveys an observed concentration of 7.8 nests/km/season in the Kouf National Park. Comparison with nest densities on nesting sites daily surveyed in Greece, Turkey and Cyprus shows that the Libyan sites are major nesting areas (Table 3). The monitoring of Libyan sites during the whole nesting season might perhaps reveal nest densities equal to those at Dalyan and even Zakynthos (Table_3).

4-1-2 Terrestrial predation

4-1-2-1 Nest predation

Nest predation was observed along the whole coastline investigated and the rate of nest predation detected during single prospectings was 44.8%. At Akyatan (Turkey), nest predation for the green turtle was found in 41.2% of nests detected during a first prospecting (Brown & Macdonald 1995) and these authors estimate at more than 75% the rate of predation at this nesting site. In Southern Cyprus, Demetropoulos & Hadjichristophorou (1989) indicate that 70% of the nests of sea turtles are opened by predators, while at Kiparissia Bay (Margaritoulis 1988b) and at the Goksu Delta (Turkey) (Van Piggelen & Strijbosch 1993) the predation rates of loggerhead nests recorded through crawl track observations on beaches monitored throughout the season, are respectively 48.4 and 40.2%.

Apart from Zakynthos, an island in the Ionian Sea where foxes are absent (Margaritoulis *et al.* 1991), nest predation is observed throughout the Mediterranean basin. Generally, nest predation is a natural phenomenon linked to the ecological diversity of the area around a nesting beach and to a low level of human disturbance.

4-1-2-2 Nesting female predation

Schleich (1987) first revealed nesting female predation on Mediterranean nesting beaches. He observed 5 females killed by predators in the Kouf National Park in June 1983. Our observation in June 1995 of 2 females killed on the beach of Oum el Frais confirms the existence of this phenomenon in Libya and on beaches other than those of the Kouf National Park. This activity has also been described in Turkey on the beaches of the Goksu Delta, where Peters *et al.* (1994) found 7 female loggerhead turtles killed, probably by jackals: 4 in 1991 and 3 in 1992. The predation of nesting females on land is connected to the still natural state of the surrounding areas, which can harbour populations of this large carnivore.

Predation by wild fauna is a factor of natural mortality which generally does not constitute a threat. However, in the context of sea turtle conservation biology, many authors present nest predation as a threat and propose its control as a conservation measure. This attitude can be crititicized in two ways: (1) it is not logical because these authors finally propose an increase in the number of individuals for compensating quality degradation of sea turtle pelagic and land habitats (Frazer 1992), (2) artificially increasing egg/hatchling survival has a small effect on population dynamics (Crouse *et al.* 1987, Laurent *et al.* 1992, Laurent 1993). It is much more effective to orient the conservation effort to reducing individual mortality in the sea, especially large size individual mortality (Laurent *et al.* 1992, Laurent 1993). We believe that the 25 nesting females killed by fishermen on the beaches and recorded in 1995 during this survey, is a fact far more serious for the future of the Libyan sea turtle population than is predation of nests and nesting females by different species of carnivore.

4-1-3 Size of nesting females

We compared the Libyan sample (m=78.05 cm, SD=4.01, N=11) to those of Kiparissia Bay in Greece (m=83.14 cm, SD=4.7, N=72, Margaritoulis 1988b) and Alagadi in Northern Cyprus (m=72.95 cm, SD=4.81, N=43, Godley & Broderick 1994). Nesting females observed in Libya in 1995 are significantly smaller than those of Greece ($F=1.37$, $df=71,10$, $P>0.05$; $t=3.82$, $df=81$, $P<0.01$), and significantly larger than those of Northern Cyprus ($F=1.44$, $df=42,10$, $P>0.05$; $t=3.6$, $df=52$, $P<0.01$).

The mean size of nesting females in Libya may be different than those of Greece and Northern Cyprus, which supports the hypothesis of loggerhead population structuring in the Mediterranean (Laurent *et al.* 1993, Laurent 1994).

4-1-4 Population size

The mean annual number of nests laid in Libya calculated in the present study is an estimate based on extrapolation of field nesting data collected during single beach prospectings. This method of estimation shows a margin of error, but as a first approach we consider it valuable for giving an order of magnitude, to be seen as minimal because lifetime of the NCT is probably over-estimated (see Material and Methods).

One could question the representivity of our spatial sampling for the whole Libyan coast. The 50 beach samples were spread over the coastal zone between the Egyptian border and Sirte, which represents 67% of the Libyan coast and contains 65 % of the sandy beaches of this country, and nesting activity was found to be distributed over this whole coastal zone (Table 1, Map 1). Therefore, we can reasonably accept that this long coastal zone is representative of the whole Libyan coast, since ecological factors explaining nesting activity variations within a nesting

area are unknown. Elements on high nesting activity over the remaining 33% of Libyan coasts not investigated during the present survey, but collected during other surveys (Laurent *et al.* 1990, Bradai 1993, Reynolds *et al.* 1995, Hadoud & Assigier 1995), corroborate this supposition. Estimate of the total length of Libyan sandy coasts was calculated by measurements on recent accurate 1/50,000 maps the sandy coastline presenting no human installations such as towns, cities, harbours, etc. As regards temporal sampling, we emphasize that monitoring of Mediterranean nesting beaches during the whole nesting season showed that egg laying spreads over 3 months according to a typical temporal ditribution structured by 3 phases; the second phase starts at the end of June in Turkey and Cyprus, but later in July in Greece. We reasonably supposed that a similar distribution occurs in Libya and therefore we spread single beach prospectings over the first and beginning of the second phases.

The estimate of 9,000 nests/season in Libya correspond to an estimated mean density of 7.82 nests/km/season, which is not particularly high in comparison to those recorded in Greece or Turkey (Table 3). It is equivalent to the mean nest density (7.9 for 66 km of beaches) measured in 1994 and 1995 on the whole coastline of Northern Cyprus (Godley & Broderick 1994, Broderick & Godley 1995, Table 3). We firmly believe that the high mean annual number of nests in Libya is primarily related to its very long sandy coasts still in a natural state and the low sea turtle fishing exploitation compared to Tunisia and Egypt. However this estimate should be improved by further surveys of the Libyan coast.

With an estimate of 9,000 nests/season, Libya has the largest loggerhead nesting colony in the Mediterranean, 2 or 3 times greater than in Greece or Turkey, and corresponding probably to more than 60% of the loggerhead nesting activity in this sea (Table 4). It must be pointed out that most of the nests recorded in Mediterranean countries were censused as NCT, thus authorising this comparison. Our study provides a first estimate of the current size of the whole Mediterranean loggerhead

nesting population (Table 4), which is of great value for demographic modeling and population dynamics analysis oriented towards conservation goals. It shows also that the Mediterranean population is large and may constitute the third largest population in the world after those of Oman and the United States.

4-2 Threats

4-2-1 Interactions with fisheries

Fishing techniques in the Mediterranean responsible for a large number of incidental catches (drifting longlines and drifting nets) are used in Libya by small coastal fishing boats and not on a large scale as in Spain or Italy by big fleets (Aguilar *et al.* 1992, De Metrio & Megalofonou 1988). Trawling which also involves numerous incidental captures in Tunisia (Laurent *et al.* 1990, Bradai 1992, Laurent & Lescure 1994) and Egypt (Laurent *et al.* 1996) is still undeveloped in Libya. However interactions with trammel nets and gillnets placed near nesting beaches during the nesting season are unknown although sea turtle halieutic mortality with this fishing gear is high, estimated at 50% in some countries (Laurent 1991, Argano *et al.* 1992). Further, we do not know whether turtles caught by Libyan trawling activity - a fishing technique which in the Mediterranean leads to very low sea turtle halieutic mortality (Laurent & Lescure 1994, Laurent *et al.* 1996) - are always released or may sometimes be killed by Egyptian fishermen who are known to eat them (Laurent *et al.* 1996). Finally intentional catches for food purposes involving the deaths of at least 25 nesting females were recorded at Driana (see above) and we may speculate on the extent of this practice.

In conclusion it can reasonably be assumed that sea turtle catches in Libya are recent and compared to other Mediterranean countries, relatively low. In addition,

unlike Egypt and Tunisia (before 1990) no commercial use for marine turtles in Libya is evident. However, the impact from a population dynamics point of view is probably not negligible, because these catches, in this country of high nesting activity, directly involve adult individuals and it must be borne in mind that the fishing sector will develop considerably in coming years.

4-2-2 Coastal urbanisation

In Libya, few people inhabit the coastal fringe and tourism is non-existent. Apart from the areas around towns and industrial centres, most of the Libyan coast is still protected from anthropic deterioration and remains wild. This situation for a large expanse of willd sandy coast seems unique in the Mediterranean. However, the current situation risks being totally changed since a Ministry of Tourism was formed in July 1995.

5 RECOMMENDATIONS

The loggerhead turtle nesting sites discovered in Libya turned out to be among the main nesting areas for the species in the Mediterranean; this heritage should be protected. The exceptional situation in the Mediterranean could facilitate the creation of a Libyan conservation strategy for this species; most of the coast is completely unspoiled by human development, fishing is only slightly exploited and tourism practically non-existent. Here Libya can become a model for conservation, management and planning of the large diversity of its coastal fringe. The protection of nesting beaches should be taken into account in all future planning for the coastal areas.

Proposed actions

Educational programme on sea turtle protection for the fishing world

Advantage should be taken of the present low-level development in fishing; a really serious policy of informing and awareness-raising on protection of sea turtles should be established in order to anticipate and avoid the adverse consequences of future sea turtle and fishery interactions. With assistance from different sources, this policy would operate at all levels in the fishing sector: fishing schools, administration, markets, ports, boats, etc. Libya can serve as a model for a later widening of such a pilot scheme throughout the whole Mediterranean.

Knowledge of how certain fishing devices are being used, and how they interact with sea turtles, would allow direction to be given to future actions. Investigations concerning interaction of sea turtles with trawling, gillnets and fishing with dynamite, are indispensable.

Censusing nesting activities along the whole coast

It is essential to continue the censusing of the nesting activity in order to acquire, as rapidly as possible, detailed mapping of nesting beaches along the whole coast and a more accurate estimate of the mean annual nest number in Libya.

-That part of the coast between Sirte and the Tunisian border is to be prospected in the next few years. The use of Quads (4 wheeled bikes) would help in this project and would increase its effectiveness and productiveness. These vehicles would allow prospecting to take place swiftly and completely safely on the long beaches, access to which by road is often very difficult, even impossible, and would assure transport of all the required equipment.

-Continue prospecting the area between the Egyptian border and Sirte.

6 REFERENCES

AGUILAR R., J. MAS & X. PASTOR. 1992. Impact of Spanish swordfish longline fisheries on the loggerhead sea turtle *Caretta caretta* population in the Western Mediterranean. Pages 1-6 *in*: *Proceedings of the Twelfth annual workshop on sea turtle biology and conservation.* Richardson J.I. and T.H. Richardson (ed). NOAA, NMFS, SFSC, Miami.

AGUILAR R., J. MAS & X. PASTOR. 1993. Las tortugas marinas y la pesca con palangre de superficie en el Mediterraneo. Greenpeace Internacional. Proyecto Mediterràneo. Palma de Mallorca. Islas Baleares. Agosto 1993. Unpublished.

ANONYME 1967. Turtles and seals in Turkey. *Oryx* 9: 176-177.

ARGANO R. 1979. Preliminary report on western Mediterranean sea turtles. Unpublished annual report on WWF Project N° 1474. Unpublished.

ARGANO R. & F. BALDARI. 1983. Status of western Mediterranean sea turtles. *Rapport Commision International Exploration Scientifique Mer Méditerranée* 28: 233-235.

ARGANO R., R. BASSO, M. COCCO & G. GEROSA. 1992. New data on loggerhead (*Caretta caretta*) movements within Mediterranean. *Boll. Mus. Ist. Biol. Univ. Genova* 56-57: 137-164.

ASHKENAZI S. & A. SOFER. 1988. Conservation of the endangered sea turtles *Chelonia mydas* and *Caretta caretta* in Israël. *Rapp. Comm. int. Mer Medit.* 31(2): 286-286.

ARMSBY J.K. 1980. Kouf national park marine survey final report: April-July, 1980. ACSAD. Unpublished.

BARAN I & M. KASPAREK. 1989. Marine Turtles Turkey. Status survey 1988 and recommendations for conservation and management. WWF report. Heidelberg.

BOWEN B., J.C. AVISE, J.I. RICHARDSON, A.B. MEYLAN, D. MARGARITOULIS & S. HOPKINS-MURPHY. 1993. Population structure of the loggerhead turtle *Caretta caretta* in the northwest Atlantic Ocean and Mediterranean Sea. *Conservation Biology* 37(4): 834-844.

BOWEN B., A.B. MEYLAN, J.P. ROSS, C.J. LIMPUS, G.H. BALAZS & J.C. AVISE. 1992. Global population structure and natural history of the Green turtle (*Chelonia mydas*) in terms of Matriarcal phylogeny. *Evolution* 46: 865-881.

BRADAI M.N. 1992. Les captures accidentelles de *Caretta caretta* au chalut benthique dans le Golfe de Gabès. *Rapp. Comm. int. Mer Medit.* 33: 285.

BRADAI M.N. 1993. La nidification de la Tortue marine *Caretta caretta* dans le sud-est de la Tunisie. Rapport pour le RAC/SPA et l'Association de la Protection de la Nature et de l'Environnement à Sfax (APNES). Unpublished.

BRADAI M.N. 1995a. Impact de la pêche sur la tortue marine *Caretta caretta* sur les côtes sud-est de la Tunisie. *Rapp. Comm. int. Mer Medit.* 34: 238.

BRADAI M.N. 1995b. Nidification de la Caouanne *Caretta caretta* sur les plages sud-est de la Tunisie. *Rapp. Comm. int. Mer Medit.* 34: 237.

BRODERICK A. & B. GODLEY. 1993. Glasgow University turtle conservation expedition to Northern Cyprus 1993. Expedition report. Dept. Vet. Anatomy, Glasgow University Vet. School, Beardsen, Glasgow; G61 1 QH, UK.

BRODERICK A. & B. GODLEY 1995. Glasgow University turtle conservation expedition to Northern Cyprus, 1995. Expedition report. Dept. Vet. Anatomy, Glasgow University Vet. School, Beardsen, Glasgow; G61 1 QH, UK.

BROWN L. & D. MACDONALD. 1995. Predation on Green turtle (*Chelonia mydas*) nests by wild canids at Akyatan beach, Turkey. *Biolo. Conserv.* 71(1): 55-60.

BUNDY G. 1976. The birds of Libya. British Ornithologist'Union, London.

CAMINAS J.A. 1988. Incidental captures of *Carettta caretta* with surface long-lines in the western Mediterranean. *Rapp. Comm. int. Mer Medit.* 31: 285.

CAPRA F. 1949. La *Dermochelys coriacea* (L.) nel Golfo di Genova e nel Mediterraneao. *Ann.Mus.Civ.Stor.Nat.Genovo* 63: 270-282.

COCCO M., R. ARGANO & R. BASSO. 1988. Loggerhead (*Caretta caretta*) in italian waters. *Rapp. Comm. int. Mer Medit.* 31: 287.

CROUSE D.T., L.B. CROWDER & H. CASWELL. 1987. A stage-based population model for loggerhead sea turtles and implications for conservation. *Ecology* 68: 1412-1423.

DELAUGERRE M. 1987. Statut des Tortues marines de la Corse et de la Méditerranée. *Vie Milieu* 37: 243-264.

DE METRIO G. & P. MEGALOFONOU. 1988. Mortality of Marine Turtles *Caretta caretta* and *Dermochelys coriacea* consequent to accidental capture in the Gulf of Taranto. *Rapp. Comm. int. Mer Medit* 31: 285.

DE METRIO G., G. PETROSINO, A. MATARRESE, A. TURSI & C. MONTANARO. 1983. Importance of fishery activities with drift lines on the populations of *Caretta caretta* and *Dermochelys coriacea* (Reptilia, Testudines), in the Gulf of Taranto. *Oebalia* 9: 43-53.

DEMETROPOULOS A. 1971. Pollution of the sea and conservation of marine life. *Annual Report on the Cyprus Fisheries* 15.

DEMETROPOULOS A. & M. HADJICHRISTOPHOROU. 1988. Turtles and Turtle conservation in Cyprus (handout to visitors to the Lara Turtle Station). Department of Fisheries. 3p. Unpublished.

DI PALMA M.G. 1978. Notizie sulle tartarughe marine in Sicilia. *Naturalista siciliano* 2: 1-6.

ERK'AKAN F. 1993. Nesting biology of loggerhead turtles *Caretta caretta* on Dalyan beach, Mugla-Turkey. *Biol. Cons.* 66: 1-4.

FAO 1993. GFCM statistical bulletin N°9. Nominal catches 1979-1991. FAO, Rome.

FAO 1995. Statistiques des pêches, captures et quantités débarquées. Vol. 76, 1993. FAO, Rome.

FRAZER N.B. 1992. Sea turtle conservation and halfway technology. *Conservation Biology* 6(2): 179-184.

GELDIAY R. 1978. Progress report on marine turtles living along the Agean and Mediterranean coasts of Turkey (after the egg-hatching season in September 1978). 11p. Unpublished.

GELDIAY R., T. KORAY & S. BALIK. 1982. Status of sea turtle populations (*Caretta caretta* and *Chelonia mydas*) in the northern Mediterranean Sea, Turkey. Pages 425-434 *in Biology and conservation of sea turtles*, K.A. Bjorndal (ed). Smithsonian Institution Press, Washington D.C..

GEROSA G., CASALE P. & S. YERLI. 1995. Report on a sea turtle nesting beach study (Akyatan, Turkey), 1994. Proc. International Congress of Chelonian Conservation Gonfaron, 6-9 July 1995 (*in press*).

GODLEY B. & A. BRODERICK. 1992. Glasgow University turtle conservation expedition to Northern Cyprus 1992. Expedition report. Dept. Vet. Anatomy, Glasgow University Vet. School, Beardsen, Glasgow; G61 1 QH, UK.

GODLEY B. & A. BRODERICK. 1994. Glasgow University turtle conservation expedition to Northern Cyprus, 1994. Expedition report. Dept. Vet. Anatomy, Glasgow University Vet. School, Beardsen, Glasgow; G61 1 QH, UK.

GRAMENTZ D. 1989. Marine turtles in the central Mediterranean Sea. *Centro* 1(4): 41-56.

HADOUD D. 1992. Survey report on aquaculture site selection. Marine Research Centre of Tajura. Unpublished.

HADOUD D. & ASSIGIER F. 1995. Survey of sea turtle in eastern part of Libya. Premier Congrès Magrébin des Sciences e la Mer. Hammamet - Tunisie, 20-22 Nov. 1995.

HADOUD D. & S. W. ZAGOUZI. Notes on sea birds from Farwah islands, north-west of Libyan coasts. (*in press*).

HERBERT J. 1979. Kouf national park. Wildlife survey and development. The Arab center for the studies of arid zones and dry lands. Unpublished.

HORNELL J. 1935. Report on fisheries of Palestine. Crown Agents for the Colonies, London.

KASPAREK M. 1994. Marine turtles in Syria. Survey of the Syrian coasst. Report for Medasset and HCI. Unpublished.

KASPAREK M. 1993. Marine turtles in Egypt. Phase I. Survey of the Mediterranean coast between Alexandria and El-Salum. Report for Medasset and RAC/SPA. Unpublished.

KERAMBRUN, P. 1986. Coastal lagoons along the southern Mediterranean coast (Algeria, Egypt, Libya, Morocco, Tunisia). Description and bibliography. UNESCO reports in marine Science 34, UNESCO, Paris.

KULLER Z. 1995. Nesting of marine turtles in the Mediterranean coast of Israël-Summer 1994. *Isr. J. Zool.* 41(1): 96.

LAMBOEUF M. & J.E. REYNOLDS. 1994. The fishing fleet of Libya: preliminary results of the 1993 frame survey. Tripoli/Rome, FAO. FI: DP/LIB/88/009 & GCP/LIB/O21/IsDB, Technical Briefing Notes 16.

LAURENT L. 1990. Les tortues marines en Algérie et au Maroc (Méditerranée). *Bulletin de la Société Herpétologique de France* 55: 1-23.

LAURENT L. 1991. Les Tortues marines des côtes françaises méditerranéennes continentales. *Faune de Provence (C.E.E.P.)* 12: 76-90.

LAURENT L. 1993. Une approche de biologie de la conservation appliquée à la population de Caouanne *Caretta caretta* de Méditerranée. Thèse de Doctorat de l'Université Paris VI.

LAURENT L. 1994. Use of mitochondrial DNA to generate genetic markers for identifying loggerhead sea turtle *Caretta caretta* populations exploited by Mediterranean fisheries and assessing fishery impacts. Analysis of the control region sequence polymorphism. Report for WWF International Mediterranean Programme, RAC/SPA and Greenpeace Mediterranean Sea Project. Centre d'Analyse Moléculaire de la Biodiversité. Université Lyon 1. Unpublished.

LAURENT L., E.M. ABD El-MAWLA, M.N. BRADAI, F. DEMIRAYAK & A. ORUC. 1996. Reducing sea turtle mortality induced by Mediterranean fisheries: trawling activity in Egypt, Tunisia and Turkey. Report for the WWF International Mediterranean Programme. WWF Project 9E0103.

LAURENT L. & J. LESCURE. 1994. L'hivernage des tortues Caouannes *Caretta caretta* dans le sud tunisien. *Rev. Ecol. (Terre et Vie)* 49: 63-86.

LAURENT L., J. CLOBERT & J. LESCURE. 1992. The demographic modeling of the Mediterranean sea turtle population: first results. *Rapp. Comm. int. Mer Medit* 33: 300.

LAURENT L., J. LESCURE, L. EXCOFFIER, B. BOWEN, M. DOMINGO, M. HADJICHRISTOPHOROU, L. KORNARAKY & G. TRABUCHET. 1993. Genetic studies of relationships between Mediterranean and Atlantic populations of loggerhead turtle *Caretta caretta* with a mitochondrial marker. *Comptes Rendus de l'Académie des Sciences*, Paris, 316: 1233-1239.

LAURENT L., S. NOUIRA, A. JEUDY DE GRISSAC & M.N. BRADAI. 1990. Les Tortues marines de Tunisie: premières données. *Bulletin de la Société Herpétologique de France* 53: 1-17.

LAZAR B. & TVRTKOVIC N. 1995. Marine turtles in the eastern part of the Adriatic sea: preliminary research. *Nat. Croat.* 4(1): 59-74.

LEMOALLE J. & M.A.M. SAAD. 1987. Lagune côtière de Libye et lac de deltas d'Egypte. Pages 63-74 *in*: *African wetlands and shallow water bodies*, Burgis M.J. and J.J. Symoens (ed), ORSTOM.

MARGARITOULIS D. 1980. Nesting of the sea turtles *Caretta caretta* on Zakynthos Island. *Bull. Hell. Soc. Prot. Nat.* 22: 41-43.

MARGARITOULIS D. 1981. Preliminary observations on the breeding behavior and ecology of Caretta caretta in Zakynthos, Greece. Pages 323-332 *in: 2ème congrès international sur la zoogéographie et l'écologie de la Grèce et des régions avoisinantes*. Athènes.

MARGARITOULIS D. 1987. Nesting activity and factors affecting breeding of the Loggerhead sea turtle *Caretta caretta* in Greece. Ministry of the environment, Physical Planning and public works, Athens. Final report on contract N°ENV-790-GR. Unpublished.

MARGARITOULIS D. 1988a. Post-nesting movement of loggerhead sea turtles tagged in Greece. *Rapp. Comm. int. Mer Medit.* 31(2): 284-284.

MARGARITOULIS D. 1988b. Nesting of the Loggerhead sea turtle *Caretta caretta* on the shores of Kiparissia Bay, Greece, in 1987. *Mesogee* 48: 59-65.

MARGARITOULIS D. 1989. Determination of nesting habitats of *Caretta caretta* in Greece (1989: western Peloponesus). A report to the EEC (Contract 6610/89/39). Unpublished.

MARGARITOULIS D. & D. DIMOPOULOS. 1995. The loggerhead sea turtle *Caretta caretta* on Zakynthos: population status and conservation efforts during 1994. Sea turtle Protection Society of Greece, Athens.

MARGARITOULIS D., D. DIMOPOULOS & L. KORNARAKI. 1991. Monitoring and conservation of *Caretta caretta* on Zakynthos. 1990 report submitted to the EEC (Medspa-90-1/GR/28/GR/05) and WWF (project 3825). Unpublished.

MARGARITOULIS D., M. DRETAKIS & A. KOTITSAS. 1992. Discovering new nesting areas of *Caretta caretta* in Greece. Pages 214-217 *in*: *Proccedings of the Twelfth annual workshop on sea turtle biology and conservation*. Richardson J.I. and T.H. Richardson (ed). NOAA, NMFS, SFSC, Miami.

MARGARITOULIS D., N. KOUSIAS, G. NICOLOPOULO & K. TENEKETZIS. 1992. Incidental catch of sea turtles in Greece: the case of Lakonikos bay. Pages: 168-170 *in: Proceedings of the eleventh annual workshop on sea turtle biology and conservation*. Salmon, M. and J. Wyneken (ed). U.S Departement of Commerce. NOAA. NMFS., Miami.

MARGARITOULIS D., Chr. PAPPA & K. TENEKETZIS. 1995. Monitoring and conservation of the *Caretta caretta* populations nesting at Kiparissia Bay and Lakonikos Bay during 1994. Sea turtle Protection Society of Greece, Athens.

MARINOS P. 1981. On the distribution of sea turtles in greek waters. *Marine Turtle Newsletter* 19: 13-14.

MAS J. & P. GARCIA. 1990. Tortues marines dans la zone Levantine de la Péninsule ibérique. *Rapp. Comm. int. Mer Medit.* 32(1): 240-240.

MEININGER L., P. A. WOLF, D. A. HADOUD & M.F. ESSGHAIER. 1994a. Ornithological survey of the coast of Libya, July 1993. WIWO-report 46. WIWO, Zeist.

MEININGER L., P. A. WOLF, D. A. HADOUD & M.F. ESSGHAIER. 1994b. Rediscovery of lesser crested terns breeding in Libya. *Brit. Birds* 87: 160-170.

OWENS D.W. & G.J. RUIZ. 1980. New methods for obtaining blood and cerebrospinal fluid from marine turtles. *Herpetologica* 36(1): 17-20.

PANOU A., G. ANTYPAS, Y. GIANNOPOULOS, S. MOSCHONAS, G. MOURELATOS, P. TOUMAZATOS, L. TSELENTIS, N. VOUTSINAS & V. VOUTSINAS. 1992. Incidental catches of Loggerhead turtles *Caretta caretta* in swordfish long lines in the Ionian Sea. *Testudo* 3: 1-6.

PETERS A., J.F. VERHOEVEN, D.C.G. VAN PIGGELEN & H. SRTIJBOSCH. 1994. *Caretta caretta* (Loggerhead sea turtle) predation. *Herpetol.Rev.* 25(3): 120-120.

PNUE. 1988. Le Plan Bleu. Plan d'action pour la Méditerranée. Avenir du bassin méditerranéen. Environnement-Developpement 2000-2025. PNUE. Athènes.

PRITCHARD P., P. BACON, F. BERRY, A. CARR, J. FLETEMEYER, R. GALLAGHER, S. HOPKINS, R. LANKFORD, M.R. MARQUEZ, L.OGREN, W. PRINGLE, H. REICHART & R. WITHMAN. 1983. Manual of sea turtle research and conservation techniques, 2nd ed.Center for Environmental Education, Washington, D.C..

RAGA J.A. & J. SALINAS. 1990. Recuperacion y marcaje de la tortuga boba (*Caretta caretta*) en aguas de la communidad Valenciana. *Medi Naturali* 2: 79-84.

REYNOLDS J.E, D.A. HADOUD & F. VALLET. 1995. Prospects for aquaculture development in Libya. Libfish field documents N°9. Tripoli/Rome, FAO.

REYNOLDS J.E, M. LAMBOEUF, A.BEN ABDALLAH, A. ABUKHADER, R. ABDULBARI & A. NAFATI. 1994. Preliminary findings of the 1993 Libyan marine fisheries. Frame survey: worshop proceedings. Tripoli/Rome, FAO. FI: DP/LIB/88/009 & FI: GCP/LIB/021/lsDB, Technical briefing notes 11.

SCHLEICH H.H. 1987. Contributions to the herpetology of Kouf National Park (NE-Libya) and adjacent areas. *Spixiana* 10(1): 37-80.

SELLA I. 1980. Too late for sea turtles ? *Israel Land and Nature* 5(4): 150-153.

SELLA I. 1982. Sea turtles in the eastern Mediterranean and the Northern Red Sea. Pages: 417-423 *in The biology and conservation of sea turtles*. K.A. Bjorndal (ed). Smithsonian Institution Press, Washington D.C.

SOFER A. 1988. Survey of sea turtles nests in the Mediterranean shore between Ceasaria to Haifa. Summer 1986. Natures Reserves Authority, Jerusalem. Unpublished.

SUTHERLAND J.M. 1984. Report on the biology and conservation of the Loggerhead turtle, *Caretta caretta*, from the greek island Zakynthos. Unpublished.

VAN PIGGELEN D.C.G. & H. STRIJBOSCH. 1993. The nesting of sea turtles (*Caretta caretta* and *Chelonia mydas*) in the Goksu delta, Turkey, June-August, 1991. *Tr.J.of Zoology* 17: 137-149.

Table 1: loggerhead turtle nesting activity in surveyed coastal areas

Coastal Areas	Prospected beaches							Observed nesting signs								
		Coordinates						Crawl tracks						Nests		
	Reference	Latitude	Longitude	Length in km	Prospected length in km	Date	Method	UCT	FCT	NCT	CT	Total	Density	N	NCT + N Total	NCT + N Density
1-Ras Azzaz		31°57.69'	24°59.28'													
	1	31°57.34'	25°00.21'	2	2	22.06	W									
	2			0.6	0.6	22.06	M		1			1				
	3			0.6	0.6	22.06	M									
	4			1.6	1.6	22.06	M	1		1		2			1	
	5			0.4	0.4	22.06	M									
	6			2.3	2.3	22.06	M									
total					7.5							3	0.4		1	0.13
2-El Ageila		32°00.33'	24°14.45'													
	7			0.1	0.1	22.06	W									
	8	32°00.33'	24°14.61'	0.05	0.05	22.06	W									
	9			1.5	1.5	22.06	M									
	10			0.2	0.2	22.06	W									
total				1.85	1.85								0			0

Beach prospecting method: Walk (W), Motorbike (M), beaches were prospected one time except double surveys (underlined references)
UCT, FCT, NCT and N: see Material and methods - **Density:** number per km - * = long sandy coast without demarcated beach

Coastal Areas	Prospected beaches							Observed nesting signs								
		Coordinates						Crawl tracks						Nests		
	Reference	Latitude	Longitude	Length in km	Prospected length in km	Date	Method	UCT	FCT	NCT	CT	Total	Density	N	NCT + N Total	NCT + N Density
3-Ayn al Ghazalah																
Wadi Sahal	11			0.25	0.25	21.06	W	1				1				
Oum Ghigah	12	32°10.81'	23°29.36'	5.5	5.5	21.06	W	3	2	1	1	7			1	
Est Oum Ghigah	13			0.6	0.6	21.06	W	3		1		4			1	
	14	32°10.44'	23°28.11'	1.4	1.4	20.06	M/W		1	1		2			1	
Ramlet el Kardhaba	15	32°10.44'	23°25.21'	3.3	3.3	20.06	M/W	2	1	2		5			2	
Wadi as Sidr	16	32°12.30'	23°21.70'	2.5	2	19/20.06	W	5	4	5	1	15		3	8	
	17	32°12.30'	23°20.70'	0.2	0.2	20.06	W		1	1		2			1	
El Kouz	18	32°12.36'	23°20.56'	1.2	1.2	20.06	W/M	1	2	5		8		3	8	
total				14.95	**14.45**							**44**	**3**		**22**	**1.5**
4-Oum el Frais	19	32°16.00'	23°13.00'	1.2	**1.2**	19.06	W	1	1	3	2	7	**5.8**	1	**4**	**3.3**
5-Kouf National Park	20			0.7	0.7	24.06	M	1				1				
	21			0.3	0.3	24.06	M	1	2	2	3	8			2	
	22			0.6	0.6	24.06	M		2	2	1	5		1	3	
	23	32°47.07'	21°23.79'	6.6	6.6	24.06	M/W	7	9	2	1	19		3	5	
total					**8.2**							**33**	**4**		**10**	**1.2**
6-North-Benghazi																
Sidi Khalifa/Driana	24	32°17.60'	20°13.31'	*	8.8	25.06	M/W	11	12	12	7	42		1	13	
Ayn Zayanah	25	32°13.13'	20°08.78'	*	2	25.06	W	2				2				
total					**10.8**							**44**	**4**		**13**	**1.2**

Beach prospecting method: Walk (W), Motorbike (M), beaches were prospected one time except double surveys (underlined references)
UCT, FCT, NCT and N: see Material and methods - **Density:** number per km - * = long sandy coast without demarcated beach

Table 1 (continued)

Coastal Areas	Prospected beaches							Observed nesting signs								
		Coordinates						Crawl tracks						Nests		
	Reference	Latitude	Longitude	Length in km	Prospected length in km	Date	Method	UCT	FCT	NCT	CT	Total	Density	N	NCT + N Total	NCT + N Density
7-Ragata/El Badine	26	31°13.64'	20°09.24'	*	12.9	28.06	M/W	6	12	22	6	46	3.5	20	42	3.2
8-Sultan																
North-Sultan	27	31°03.58'	20°09.75'	*	8	26.06	M	4	2	10	1	17		10	20	
	27				8	29.06	M	4	10	21		35			21	
South-Sultan	28	31°02.23'	20°09.25'	*	3	26.06	W			2		2		3	5	
total					11							19	1.7		25	2.3
9-Zuwaytinah	29	30°46.87'	20°00.09'	*	15	27.06	M/W									
	29				15	29.06	M					0			0	
	29				20	29.06	M									
total					35								0			0
10-El Aquaylah	30	30°16.00'	19°11.00'	*	15.6	02.07	M/W	1	9	21	1	32	2		21	1.3
11-Um Gharaniq	31	30°20.00'	18°50.00'	*	3.5	02.07	W	3	4	6	1	14	4		6	1.7
12-Ras el Aweija		30°54.50'	17°50.00'													
	32			0.1	0.1	03.07	W									
	33			0.5	0.5	03.07	W	1		2		3			2	
	34			0.05	0.05	03.07	W	1				1				
	35			0.3	0.3	03.07	W	1				1				
	36			0.5	0.5	03.07	W		2	1		3		1	2	
	37			1.7	1.7	03.07	M		3	4		7		4	8	
total					3.15							15	4.8		12	3.8

Beach prospecting method: Walk (W), Motorbike (M), beaches were prospected one time except double surveys (underlined references)
UCT, FCT, NCT and N: see Material and methods - **Density:** number per km - * = long sandy coast without demarcated beach

Coastal Areas	Prospected beaches							Observed nesting signs								
		Coordinates						Crawl tracks						Nests		
	Reference	Latitude	Longitude	Length in km	Prospected length in km	Date	Method	UCT	FCT	NCT	CT	Total	Density	N	NCT + N Total	NCT + N Density
13-Wadi el Ahmar		31°01.19'	17°29.19'													
	38			1.4	1.4	04.07	M			1		1			1	
	39			0.7	0.7	04.07	M		1	1		2			1	
	40			0.8	0.8	04.07	M		1	2		3			2	
	41			0.2	0.2	04.07	M									
	42			0.3	0.3	04.07	M				1	1				
	43			0.6	0.6	04.07	M			1		1			1	
	44			0.4	0.4	04.07	M		2			2				
	45	31°01.31'	17°28.66'	1	1	04.07	W	1	2			3				
total					**5.4**							**13**	**2.4**		**5**	**0.9**
14-Marsa Sultan	46	31°07.00'	17°09.00'	4.5	**4.5**	04.07	M		4	5		**9**	**2**	2	**7**	**1.5**
15-Sirte-East																
	47	31°10.77'	16°59.61'	*	2.5	04.07	W	1	6	3		10		1	4	
	48	31°10.80'	16°53.24'	*	2.3	04.07	M/W	2	3	1		6			1	
	49	31°12.18'	16°47.36'	*	1.5	05.07	W		1	2	1	4			2	
	50	31°13.00'	16°40.00'	*	0.3	03.07	W		8			8		1	1	
total					**6.6**							**28**	**4.2**		**8**	**1.2**
Total single prospectings					**141.65**					**122**		**307**	**2.16**		**176**	**1.24**

Beach prospecting method: Walk (W), Motorbike (M), beaches were prospected one time except double surveys (underlined references)
UCT, FCT, NCT and N: see Material and methods - **Density:** number per km - * = long sandy coast without demarcated beach

Table 2: Comparison of marine turtle surveys along African coasts

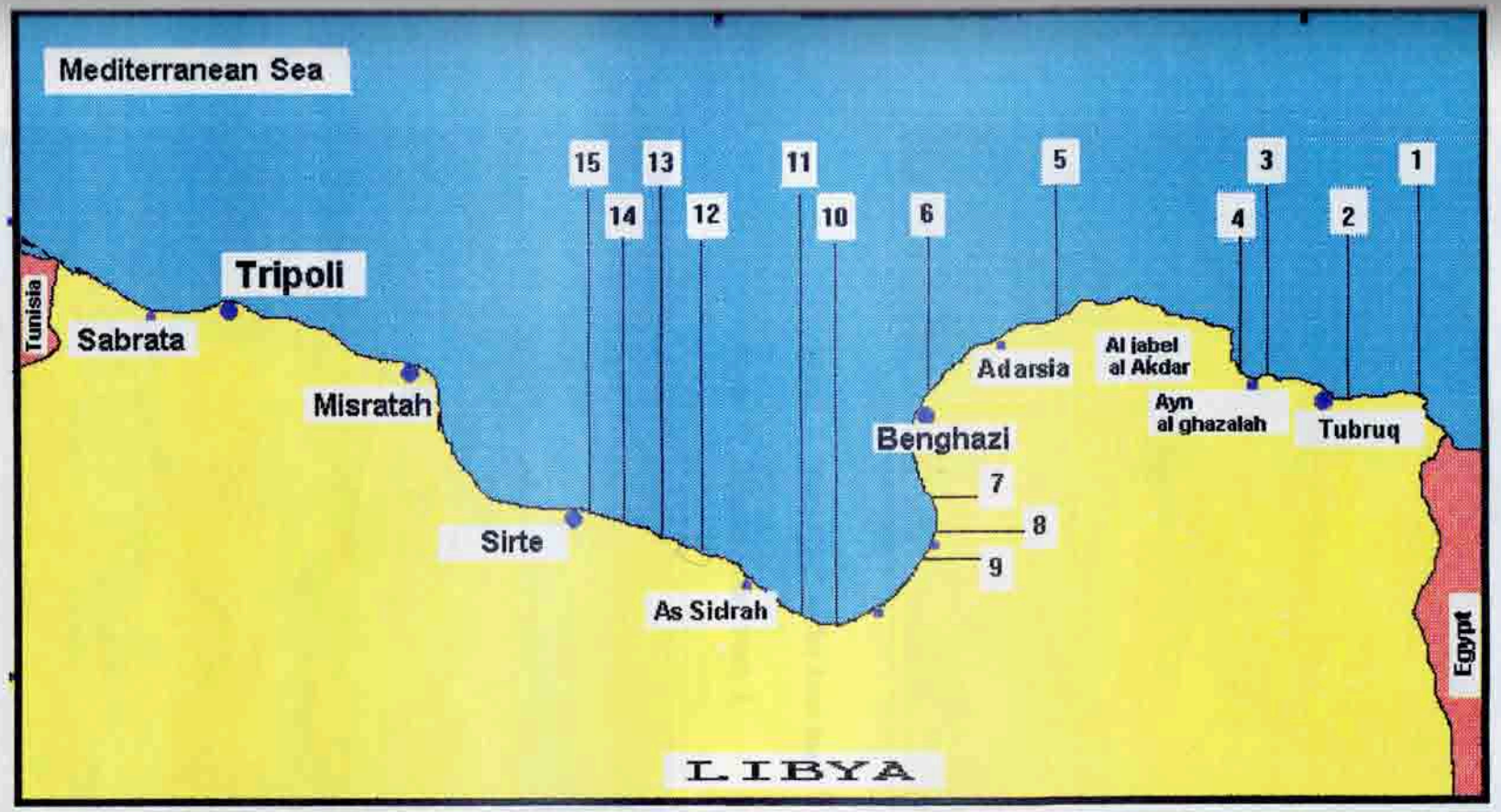
Country	Year	Nesting season duration	Total length of prospected beaches in km	Prospecting intensity during nesting season	Number of observed crawl tracks	Density crawl tracks /km	Reference
Morocco	**1989**	**-**	**24**	**1 to 3 prospectings**	**0**	**0**	Laurent 1990
Algeria	**1989**	**-**	**73.9**	**1 to 7 prospectings**	**0**	**0**	Laurent 1990
Tunisia	**1988**		**70**	**1 prospecting**	**1**	**0.014**	Laurent et al. 1990
Tunisia	**1993**	**June-August**	**60**	**2 to 4 prospectings**	**10**	**0.16**	Bradai 1993
Libya	**1995**	**?**	**141.65**	**1 prospecting**	**307**	**2.16**	Present study
Egypt	**1993**	**?**	**255**	**1 prospecting**	**10**	**0.039**	Kasparek 1993

Table 3: Major site nesting activities of the loggerhead turtle in the Mediterranean.

Country	Nesting site	Year	Nesting season duration	Surveyed length km	Survey effort during nesting season	Number of nests	Nest density Nests/km/season	Reference
Greece	Zakynthos	1990	28 May-3 Sept	3.55	Every day	926	260.8	Margaritoulis *et al.* 1991
	Zakynthos	1994	28 May-3 Sept	3.55	Every day	1499	422.2	Margaritoulis & Demopoulos 1995
	Kiparissia bay	1989	9 June-20 Aug	44	Every day	534	12.1	Margaritoulis 1989
	Lakonikos bay	1994	5 June-20 Aug	23.5	Every day	216	9.2	Margaritoulis *et al.* 1995
Turkey	Dalyan	1989	May-Aug	3	Every day	235	78.3	Erk'akan 1993
	Göksu Delta	1991	May-Aug	32.5	Every 3 or 4 days	117	3.6	Van Piggelen & Strijbosch 1993
Cyprus	North of Cyprus	1994	May-Aug	66	Every 3 days	519	7.9	Godley & Broderick 1994
	Alagadi	1994	May-Aug	2.1	Every day	95	45.2	Godley & Broderick 1994

Table 4: Extreme Estimates of mean annual number of loggerhead nests laid in Mediterranean countries.
* Minimal number of nests recorded during one nesting season;
** Maximal number

Country	Low estimate	High estimate	Reference
Italy	1 *	6 **	Gerosa (comm. pers.)
Albania	?	?	
Greece	2,662 *	3,677 **	Margaritoulis et al. 1992
Turkey	1,500	3,000	Geldiay *et al.* 1982, Baran & Kasparek 1988
Cyprus	200 245 **	300 519 **	Demetropoulos & Hadjichristophorou 1988 Godley & Broderik 1994
Syria	27*	?	Kasparek 1994
Lebanon	?	?	
Israel	5*	25**	Ashkenazi & Sofer 1988, Kuller 1995
Egypt	10 *	?	Kasparek 1993
Libya	9,000	?	Present study
Tunisia	5	50	Laurent et al. 1990, Bradai 1993, Bradai 1995b
Mediterranean	13,655	16,614	



Surveyed coastal areas	Total length in km prospected in coastal areas	Observed crawl track density during single prospecting (tracks/km)	Surveyed coastal areas	Total length in km prospected in coastal areas	Observed crawl track density during single prospecting (tracks/km)
1. Ras Azzaz	7.5	0.4	9. Zuwaytinah	35	0
2. El Ageila	1.8	0	10. El Aquaylah	15.6	2
3. Ayn al Ghazalah	14.4	3	11. Um Gharaniq	3.5	4
4. Oum el Frais	1.2	5.8	12. Ras el Aweija	3.1	4.8
5. El Kouf National Park	8.2	4	13. Wadi el Ahmar	5.4	2.4
6. North Benghazi	10.8	4	14. Marsa Sultan	4.5	2
7. El Badine	12.9	3.5	15. East Sirte	6.6	4.2
8. Shut Sultan	11	1.7			

Map 1. Location of surveyed coastal areas

Photo 1: "False Crawl" on Ras Azzaz beach ↑

Photo 2: El Badine nesting beach ↓

Photo 3: Zuwaytinah nesting beach ↑

Photo 4: El Aquaylah nesting beach ↓

Photo 5: The coastal strip East of Sirte with large sandy areas ↑

Photo 6: Rocky beach of El Mallaha located between Ras azzaz and the Egyptian border ↓

Photo 7: Fox predation on nest (El kouf nesting beach) ↑

Photo 8: Loggerhead nesting female killed by predators while digging on Oum El Frais beach ↓

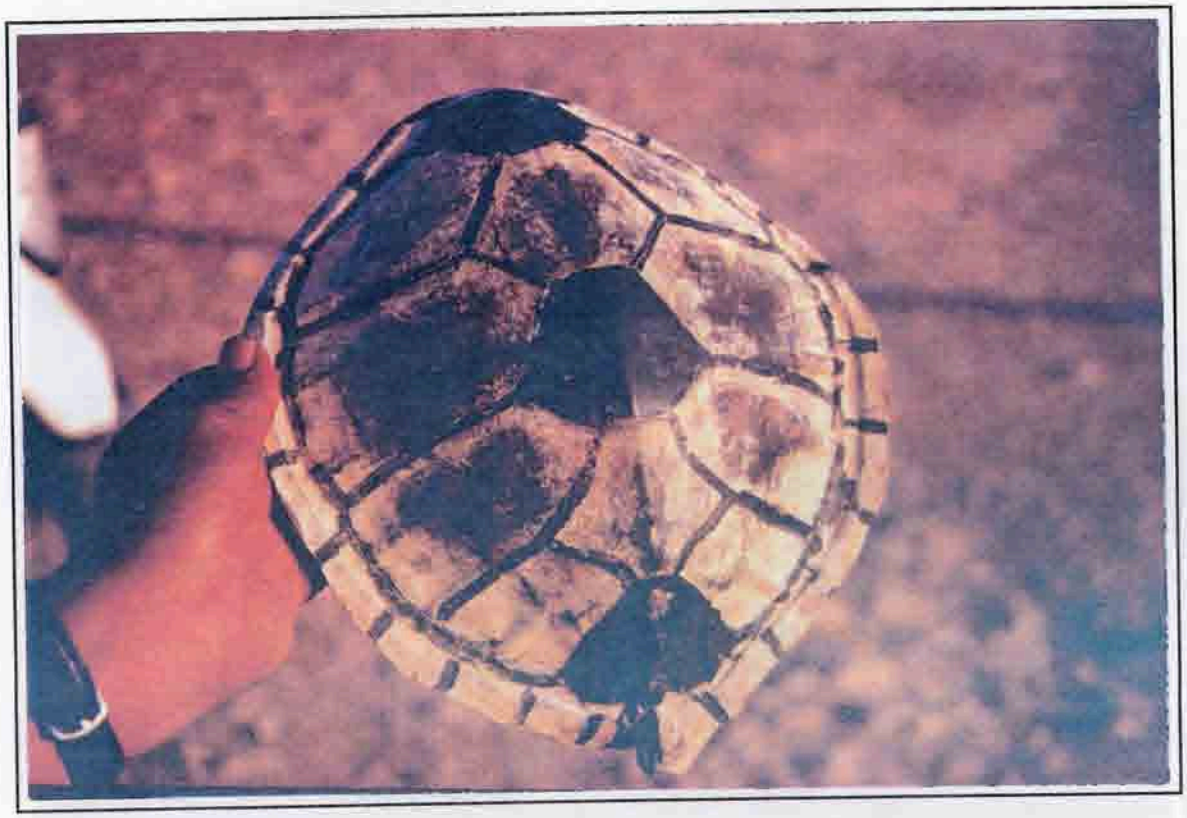


Photo 9: Juvenile Green turtle carapace. observed near Ayn al Ghazalah. ↑

Photo 10: Zuwaytinah shelter for about twelve fishing boat. ↓

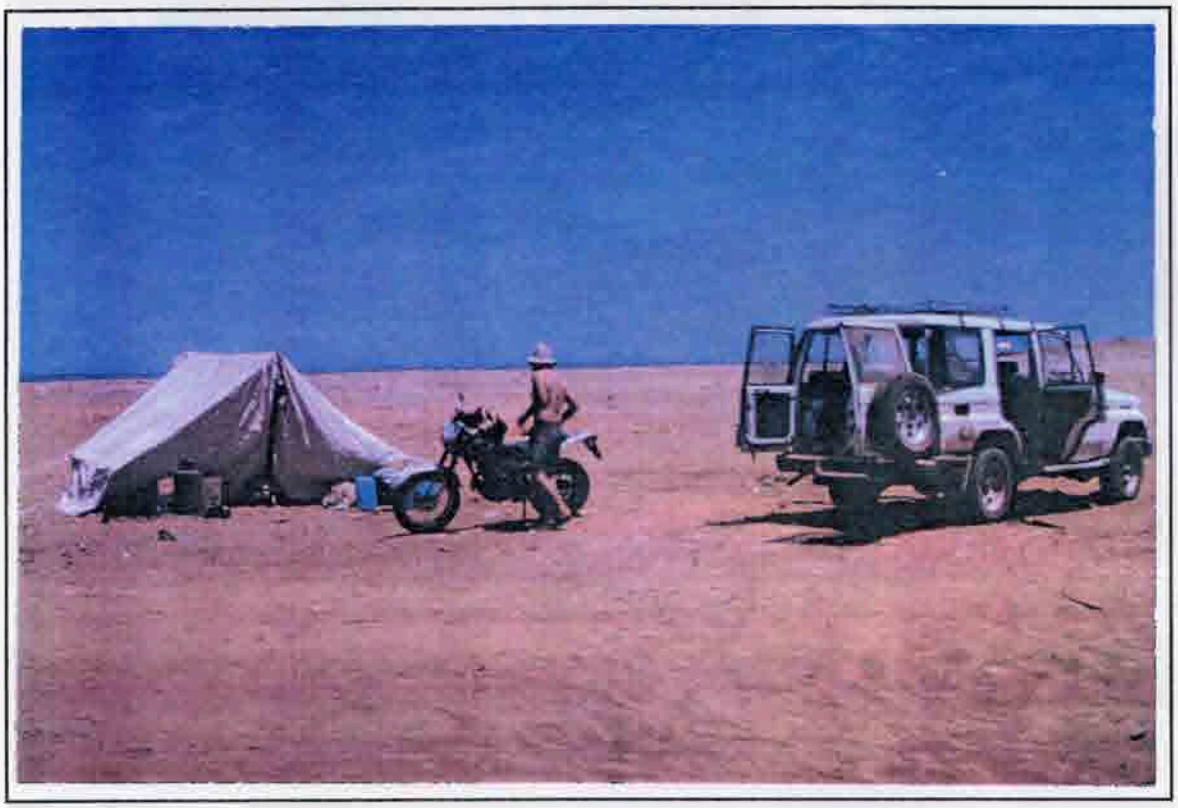


Photo 11: the survey team camping on Wadi El kouf beach. ↑

The team was made up of 5, then 6, participants, transported by 4x4 car and Yamaha TW200 motorbike. These vehicles allowed to travel quickly over large distances (6,000 km covered during the mission), to reach beaches that were not easily accessible and to transport camping gear.

Photo 12: Common crab, species seen on the majority of the surveyed nesting beaches ↑

Photo 13: Agamid observed on El Ageila beach ↓

Photo 14: Some parts of the Libyan coast are polluted by crude oil. ↑

Photo 15: Rubbish noted on some parts of the Libyan coasts (even on very wild sites) ↓

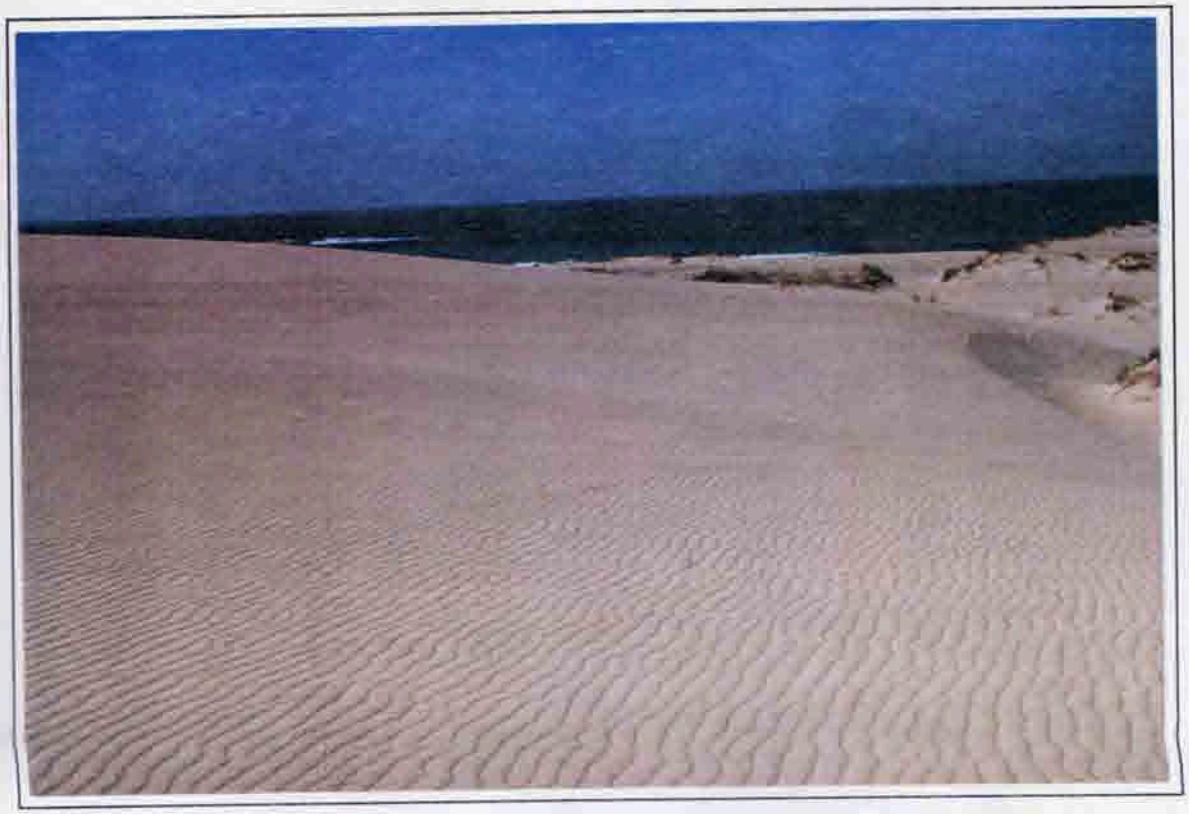


Photo 16: Unspoilt sand dunes near the sea shore on Ras Azzaz area. ↑

Photo 17: Small scale exploitation of the sand dune was observed on Oum Ghizah beach. ↓