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Compilers:

F. Alberto Abreu-Grobois
Raquel Briseño-Dueñas
René Márquez-Millán
Laura Sarti-Martínez

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William M. Daley, Secretary

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
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NATIONAL MARINE FISHERIES SERVICE
Penelope D. Dalton, Assistant Administrator for Fisheries

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AN ESTIMATION OF THE OVERALL NESTING ACTIVITY OF THE LOGGERHEAD TURTLE IN GREECE

Dimitris Margaritoulis
The Sea Turtle Protection Society of Greece, P. O. Box 51154, GR-14510 Kifissia, Greece. stps@compulink.gr

INTRODUCTION

Genetic studies have shown that loggerhead turtles *Caretta caretta* originating, most probably, from Florida colonized the Mediterranean Sea about 12, 000 years ago (Bowen *et al*., 1993).

There is evidence that loggerhead stocks in the Mediterranean have been depleted due to human exploitation, restriction and degradation of nesting areas, and incidental catch. Today, loggerheads in the Mediterranean nest mainly in the eastern oceanographic basin and particularly in Greece, Turkey, Cyprus and Libya. However no overall data for each country are available in order to assess the total nesting potential in the Mediterranean.

The loggerhead in the Mediterranean is considered a threatened species under various international and national listings. In Greece, the loggerhead turtle is protected by international conventions, European Commission directives (*e.g.* the Habitats Directive where *Caretta caretta* features as a "priority" species) and national legislation. The obligation of the States to protect *Caretta caretta* habitats and especially nesting areas (by means of land use planning, management measures, etc.) requires adequate substantiation of the nesting activity not only at the area in question but also in relation to the overall nesting potential at national and Mediterranean scale.

The present paper is an attempt to produce an estimate of the overall nesting activity of the loggerhead turtle in Greece.

METHODS

The Sea Turtle Protection Society of Greece (STPS), in the context of various projects, monitors systematically loggerhead nesting areas in Greece, some of them since 1984. Furthermore, a major investigation, with the aim to discover "new nesting areas", was conducted by the STPS from 1989 until 1992. About 7, 500 km of coastline were visited, all beaches of "soft" substrate were recorded and surveys were conducted, during the nesting season, on the most promising of them. During this work, some important nesting areas were found on the island of Crete and the extent of "diffuse" nesting was estimated (Margaritoulis *et al*., 1995).

Monitored nesting areas are precisely delimited and surveyed daily during the nesting season (from the end of May until the middle of October) with the aim to record all nests. Depending on local threats, clutches are protected, either *in situ* or by relocation to safe sites. After the emergence of hatchlings, a large number of nests are excavated in order to determine hatching success. All data are entered, locally in most cases, in computer data bases and thereafter are processed and evaluated.

In order to assess the relative significance of a nesting area and thereby co-ordinate accordingly conservation efforts, nesting beaches in Greece have been divided in three categories: areas of "major" nesting, areas of "moderate" nesting and areas of "diffuse" nesting. The selection criteria were arbitrarily set as follows: a "major" area should have an average number of nests per season (recorded over several

Table 1. The "major" nesting areas of the loggerhead turtle in Greece and their nesting potential

Nesting area	Beach length (km)	Maximum number of nests per season	Minimum number of nests per season	Average nesting density (nests/km)	Number of monitoring seasons
Laganas Bay,Zakynthos	5.5	2,018	857	235.6	14
Kyparissia Bay*	44.0	927	286	12.8	13
Rethymnon, Crete	10.8	516	316	36.6	8
Lakonikos Bay	23.5	220	107	7.3	6
Chania Bay, Crete	13.1	192	77	8.9	6
TOTAL	96.9	3,873	1,643		

* More than 83% of nests concentrate at the southernmost 10 km of Kyparissia Bay, where average nesting density reaches 47.2 nests/km/season.

seasons) of more than 100 and an average nesting density of more than 6 nests/km/season. Areas of "moderate" nesting should have an average number of nests per season between 20 and 100, irrespective of nesting density. Areas hosting less than 20 nests/season or featuring irregular nesting patterns are characterized as areas of "diffuse" nesting.

RESULTS

Considering the existing data for all nesting areas in Greece, five "major" nesting areas are recognized (Table 1). From the same table it is seen that nesting fluctuations between "good" and "bad" seasons may reach 61% (Rethymnon area). Table 2 shows areas of "moderate" nesting. Some of these areas are rather extensive (*e.g.* Ipirus coast) and more surveys are needed in order to locate possible nesting concentrations. Finally, taking into account the "diffuse" nesting (estimated at 15% on total nesting) that takes place along the 15, 000-km Greek shoreline, the overall number of loggerhead nests in Greece ranges from 5, 287 to 2, 355 (Table 3).

DISCUSSION

Existing data, most of them collected over several seasons, permit a more or less adequate estimation of the overall nesting activity of the loggerhead turtle in Greece. As most part of the Greek shoreline has been already investigated, it is unlikely that new nesting areas, with a substantial influence on the existing overall situation, will be found.

The five "major" nesting areas in Greece, totaling about 97 km in length, account for 69.8%-73.3% of the total loggerhead nesting activity (Table 3). Conservation programs are conducted by the STPS on all "major" areas, including monitoring of the turtle populations, protection of nests, public awareness activities as well as preparation and implementation of management plans. All five "major" areas have been proposed by the authorities for inclusion in the European Union's network of protected areas, known as Natura 2000, under the Habitats Directive. Especially the Bay of Laganas in Zakynthos, with its tremendous nesting potential, will soon be declared a National Marine Park.

Areas with "moderate" nesting activity account for 11.7%-15.2% of the total nesting activity in Greece (Table 3). Some of these areas (*e.g.* Kotychi lagoon, Bay of Messara) are monitored by the STPS and have also been proposed for the Natura 2000 network as they feature other important characteristics. The nesting area on the island of Kefalonia is systematically monitored by the Kefalonian Marine Turtle Project and hopefully will receive some protection by local land use planning. On the other hand, some rather extensive areas with "moderate" nesting (and subsequently with low nesting densities) are not watched over as closely as the others (*e.g.* Ipirus, Kos).

Table 2 Nesting areas in Greece with "moderate" loggerhead nesting (20<x<100 nests/season on the average)

Area	Number of nests per season
Kerkyra island (including nearby islets)	20
Ipirus coast (Preveza-Albanian border)	40
Lefkas island	50
Kefalonia island	21 - 83
Kotychi lagoon (NW Peloponnesus)	32 - 80
Yanitsena, Bouka, etc. (W Peloponnesus)	30 - 60
Romanos (SW Peloponnesus)	17 - 30
Koroni, Foinikous, etc. (S Peloponnesus)	45 - 80
Astros, Kythira, etc. (SE Peloponnesus)	20
Bay of Messara, Crete	15 - 77
Kos island	60
Rhodes island	9 - 21
TOTAL	**359 - 621**

1. Areas in geographical order from NW to the SE.
2. Two numbers per area refer to maximum and minimum numbers recorded over different seasons.
3. One number per area refers to estimation during one season.
4. Data for Kefalonia from Houghton et al., 1997.

In total, 76.5%-81% of the overall loggerhead nesting activity in Greece is, more or less, overseen very closely and efficiently, and specific legislation and management measures are in effect or soon to be effected. However, adequate enforcement of regulations and local participation have still a long way to go until they become fully operational.

Table 3 Estimation of total loggerhead nesting activity in Greece (nests per season)

Category of nesting	Maximum number	Minimum number
In "major" areas (>100 nests/season)	3,873	1,643
In areas with "moderate" nesting (20<x<100 nests/season)	621	359
"Diffuse" nesting (15% of total)	793	353
TOTAL	5,287	2,355

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