



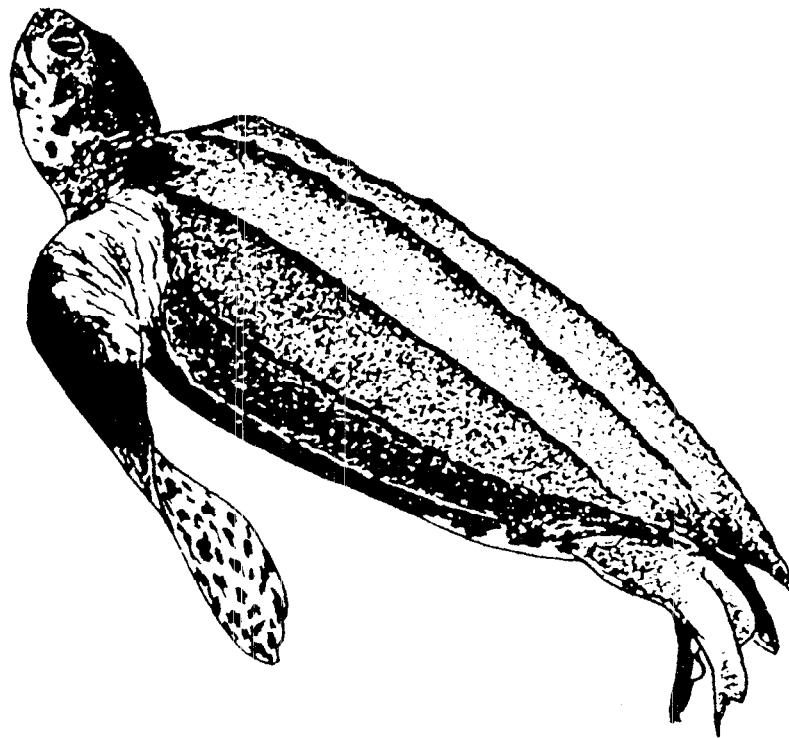
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**PROCEEDINGS OF THE FIFTEENTH ANNUAL SYMPOSIUM ON
SEA TURTLE BIOLOGY AND CONSERVATION**

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to release hatchlings from the hatchery and patrol the beach looking for nesting females. "Turtle by Night" participants come away from their experience with a good deal of knowledge about the sea turtle and a desire to spread the word about the protection of the species and its environment.

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PROTECTING LOGGERHEAD NESTS FROM FOXES AT THE BAY OF KIPARISSIA, WESTERN GREECE

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THE STUDY AREA - OBJECTIVES

The loggerhead sea turtle is considered an endangered species in the boundaries of the European Union and its main nesting areas in the Mediterranean are found in Greece (Groombridge, 1982).

As it was assessed by the work of the STPS, in the context of various projects since 1983, loggerhead turtles in Greece nest mainly on Zakynthos island, Kiparissia Bay, Lakonikos Bay and Crete. The second most important nesting area, after Zakynthos, is Kiparissia Bay.

The Bay of Kiparissia is an open bay in western Peloponnesus, at about 90 km SE from Zakynthos. Nesting takes place over a continuous beach of 44 km, between the rivers Alfios and Arcadikos, interrupted only by the river Neda (Fig. 1). The area is strongly affected by the NW winds. This creates heavy surf which usually reaches, during the summer, the high beach.

The beach, in its greater part, is backed by extensive dune fields, probably the largest in Greece. Behind the dune system and along its greater length exists a coastal pine forest. Coastal development in the form of holiday houses has almost completely covered the dune field close to the river Alfios. The majority of these houses are built illegally and destroy sand dunes and coastal vegetation. Tourism development along the Bay is generally very low and restricted to certain areas.

Monitoring work at Kiparissia Bay has shown that more than 80% of the nesting concentrates at the southern part of the Bay and specifically at the 10 km stretch between the rivers Neda and Arcadikos (Fig. 1). Furthermore, loggerhead nests along this area are subject to heavy depredation and inundation by the sea (Margaritoulis, 1988). During 1984, about 57% of the nests were depredated, while during 1989 about 62%.

Since 1990, the southern part of the Bay is the main operating area for the Sea Turtle Project at the Bay of Kiparissia. During 1994 the main objectives of the project were:

1. Monitoring of nesting activity.
2. Tagging of female turtles.
3. Protection of nests from inundation (which is effected by relocation of nests made close to the sea, to the natural beach hatchery).
4. Protection of nests in situ from predation.
5. The onset of public awareness.

In order to facilitate the work, the study area was divided in four sectors: O, A, B and C. Two field stations were established during the 1994 summer project (at Vounaki and the village of Kalo Nero). The project was accomplished with the enthusiasm and devotion of 42

volunteers from Greece and several other countries.

The work was part of the Integrated Ionian Project, financed 75% by the European Union and 25% by WWF Greece.

PROTECTING THE NESTS FROM PREDATION

The main predator of loggerhead nests at Kiparissia Bay is the red fox (*Vulpes vulpes*). The red fox is a common carnivore in Peloponnesus. Its body length is about 58-85 cm and the tail length 35-55 cm. It is usually active during the night. Its opportunistic diet includes turtle eggs and hatchlings when it visits the beach. Foxes at Kiparissia Bay live in the woodland hills behind the beach. When a fox locates a turtle nest it digs it up and throws out the top eggs which either consumes on the spot or takes away. The fox usually leaves excrement by the predated nest as a territorial sign. The predation of the same nest goes on for 3-5 consecutive nights until all the eggs are taken. Exposed eggs attract other mammals (rats and martens) and birds (hooded crows).

In 1990 preliminary efforts started to control nest predation. To protect the nests from the fox, cages were first used. Nest cages were very expensive and labour consuming to construct. They were also very difficult to transport along the beach. Furthermore, they needed continuous attention to make sure that no hatchlings were trapped in the wire mesh. In many cases, foxes could dig under the cage and reach the eggs.

In 1992 and 1993, nest cages were abandoned in favour of a special screen made of thick iron wire (diameter 4 mm). The screen could be found at the local market in large sheets of about 3.5x1.5 m which could easily be cut down to the needed size (about 60x70 cm).

Nest screens were anchored in position with bamboo sticks that are found cut in the area. Bamboo sticks were inserted about 50 cm in the sand around the screen and did not allow the fox to dig under it. The screen's openings (about 10x10 cm) were big enough to allow emerging hatchlings to pass through them but hindered the fox from digging and reaching the eggs. During 1994, only this method of nest protection was followed.

The nests were located during daily morning surveys that were done on foot (sectors O and A) or on beach bikes (sectors B and C). As soon as a fresh track was spotted it was followed up the beach to check, by the nesting spoor, whether the turtle had nested or not. In case of a nest, the sand above the nest was removed by hands in order to locate the eggs. After the location of the egg chamber, the site was covered immediately with wet sand and compacted with dry sand until the original level. Then the screen was placed on top and secured with about a dozen bamboo sticks.

In case of a nest predation, the egg-chamber and the surrounding area were cleared from destroyed eggs and the nest was covered with moist and dry sand up to its original level. Care was taken not to move the intact eggs still in the egg-chamber. Predated unprotected nests were fenced as above and protected ones were reinforced with more bamboo sticks. Destroyed eggs, eggshells and predators' excrement were taken and buried away from the beach.

Furthermore, all nests were given a code number and were marked with a small STPS sign indicating that the fenced area is a turtle nest.

RESULTS AND DISCUSSION

During the 1994 season, 577 nests were located. Of these, 88 were transferred to the beach hatchery. The other 489 were protected in situ with the screens. In addition, 123 nests were discovered during the season either after predation or after hatching. Apparently these nests escaped location during the initial search.

From the total 489 nests that were fenced, 18 nests (3.7%) were

predated, despite fencing (Table 1). Of these, only one was totally predated. Predation of fenced nests occurred either because of misplacement of the screen and the bamboo sticks or because of the top eggs being very close to the surface.

From the 123 nests that were left unfenced, 60 nests (48.8%) were depredated. Of these, 18 were predated totally. As it was mentioned before, foxes predate a nest in subsequent nights. The restriction of their ability to predate due to fencing caused the atypical behaviour of consuming all the eggs of a nest in one night.

Predation peaks of fenced nests (Fig. 2) are attributed mainly to favourable sand digging conditions due to rain or inundation by the sea (on 11 and 12 July: inundation by the sea, on 6 August: rain, e.t.c.). In both cases, sand becomes wet and this facilitates the foxes to dig up nests or tunnel under the screen.

Nest predation is closely correlated to egg development (Fig. 3). Predation was effected, on the average, 42.5 days after egg-laying ($n=78$; $s=10.1$; $CV(\%)=23.8$). At this stage eggs have started being hatched in the nest and this probably provides the necessary olfactory cues which guide the fox to locate the nest.

In total, 78 nests were predated which amounts to 11.1% of the total number of clutches laid during 1994 at Kiparissia Bay. Considering that nest predation in previous years exceeded 60% of the total number of nests, the 1994 predation rate of 11.1% manifests a very successful result for the benefit of the sea turtle.

Taking into account that clutch size during 1994 was 115 eggs and the percentage of emerged hatchlings at the surface was 70.4%, our intervention saved at least 27,688 hatchlings.

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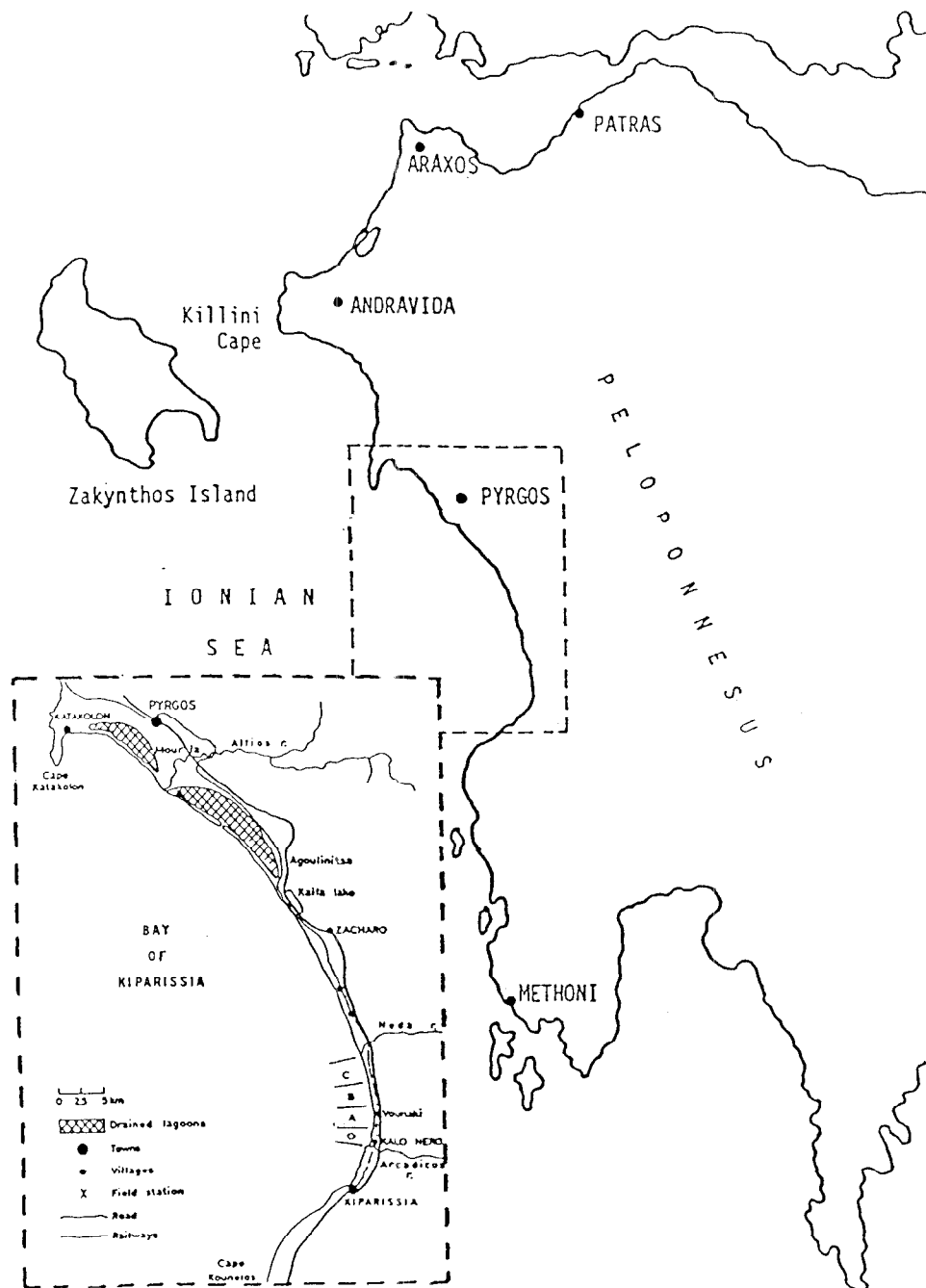


Fig. 1. Sketch maps of western Peloponnese coast showing position of Kiparissia Bay and beach sectors (O through C) where the Sea Turtle Project was carried out during 1994 nesting season.

Table 1. Comparison of predation response on protected and unprotected nests at Kiparissia Bay during 1994.

Sector	Protected nests			Unprotected nests		
	Total No	Predated	%	Total No	Predated	%
O	137	4	2.9	39	11	28.2
A	215	6	2.8	46	20	43.5
B	87	4	4.6	26	20	76.9
C	50	4	8.0	12	9	75.0
Overall	489	18	3.7	123	60	48.8

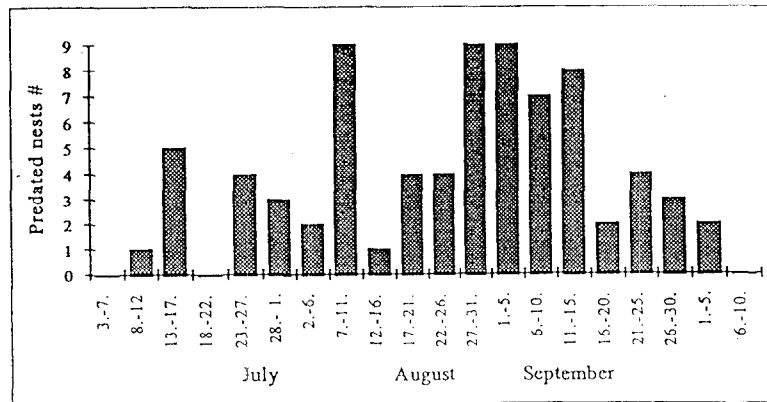


Fig. 2. Distribution of predation over the nesting season at Kiparissia Bay during 1994 (in segments of 5 days).

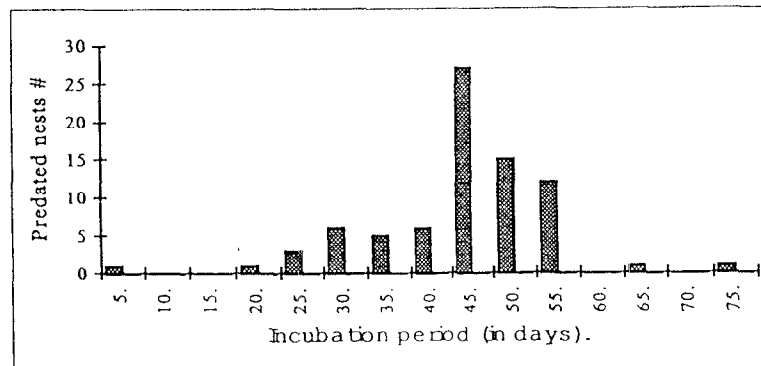


Fig. 3. Distribution of predation over the incubation period at Kiparissia Bay during 1994 (in segments of 5 days).