

## BEACH DENATURALISATION - THE EFFECTS ON NEST SITE LOCATION AND NESTING SUCCESS

Gail Schofield, Kostas Katselidis, and Dimitrios Dimopoulos

ARCHELON - the Sea Turtle Protection Society of Greece, Solomou 57, GR-104 32, Athens, Greece. Tel/Fax +30 1 5231342. E-mail: stps@archelon.gr

### INTRODUCTION

One of the most complex challenges to long-term conservation of sea turtles is the changing habitat of coastal areas, via natural and anthropogenic processes. Threats to such habitats can be defined as any action or process that can alter sand substrate of a nesting beach, injure or kill sea turtles or their eggs and/or disrupt behaviour (Witherington, 1999). Worldwide research has proved that certain substrates (fine sand; silt and clay sediments; mixed sand sorting coefficient) can negatively affect nesting and incubation success of nests. Furthermore, beach erosion, and sediment deposition can cause prime nesting areas to deteriorate.

Daphni is one of the six loggerhead nesting beaches in Laganas Bay, which are a part of the National Marine Park of Zakynthos. Daphni annually holds the second largest number of nests laid within the rookery. In order to calculate nesting value of Daphni over the last six years, these factors were assessed:

- 1) Nesting density and consistency (1984-2000)
- 2) Overall nesting success (all years) and on specific sub sectors (2000 only)
- 3) Nest location trends, for a particular subsector and between subsectors (1995-2000) on Daphni beach

### CURRENT STATUS OF DAPHNI

Legislation protects 200 metres of land behind the beach (on a horizontal transect), prohibiting construction or land alteration. Since illegal human development has occurred on Daphni, its suitability as a nesting beach has been greatly reduced because soil and stones that are washed down on to the beach alter the beach substrate. The land has high levels of erosion due to shallow soils (of high silt and clay content), high rainfall intensity and steep slopes. This is further aggravated by deliberate fires and over grazing causing root loss, which has resulted in a mosaic landscape of low scrubs and medium height grasses with intermittent areas of denuded eroded ground.

In 2000, the beach perimeter was bulldozed, flattened, reshaped, native flora uprooted, shrubs and small trees cut, non native flora planted, and beach furniture were placed in lines from 1 (A-C, F-O, S-W) to 5 rows (O-S). All are activities against current legislation. Between sunset and sunrise it is prohibited to enter the beach or to use lights, yet the bars opened illegally at night, whose customers used lights and were encouraged to walk on the beach. The removal of vegetation camouflaging the illegal buildings also lit up the beach. Furthermore on the beach, beach furniture, boats, vehicles and rubbish are forbidden. Yet the beach was bulldozed in 2000 to clear sea grass, which was dumped with rubbish rendering 20 metres of beach futile for nesting.

### METHODOLOGY

Since 1984, ARCHELON - the Sea Turtle Protection Society of Greece, annually collects monitoring information on the six major loggerhead nesting beaches in Laganas Bay. The data collected for Daphni included daily early 'morning surveys' from June to

September. Since 1995, all hatched nests have been mapped with respect to 10-20 metre subsector poles concealed within the beach vegetation line. During the 2000 nesting season, the positions of all adult female emergences were also recorded with respect to these subsectors. Essential, observational material is also collected with respect to illegal development, illegal taverna operation, sun umbrella numbers on the beach and beach perimeter, tourist numbers, and areas of sediment deposition on the beach.

### ANALYSIS AND CORRELATIONS OF THE COLLECTED DATA, 1995-2000

The data collected on Daphni suggest that its value as a nesting beach is declining. Emergence success, nesting success and nesting density data depict a marked fall for Daphni from 1993-2000. The data further support the hypothesis that turtles are moving to alternative beaches to nest. Detailed data collected on Daphni beach between 1995 and 2000, indicate that on Daphni areas that the turtles used to nest have altered, and that this change has occurred in parallel with the destruction of prime areas of nesting beach as a result of human activity (Katselidis & Dimopoulos, 1999). The data also indicate that the 'new' areas used for nesting, prove to be of poorer quality producing poorer hatching success rates and greater embryonic mortality rates. Illegal human activities on the beach, on the beach perimeter and on the land behind the beach are believed to be responsible for these changes.

Between 1984-2000, the annual nesting number of the rookery maintained an overall plateau, whereas the number of nests held on Daphni is annually declining. Until 1993 Daphni annually held the second largest number of nests (on average 12%) with respect to the total number of nests laid within the rookery; in subsequent years (1994-2000) Daphni has held between 5th and 3rd position only. The data imply that turtles, in recent years, have begun using alternative nesting sites within the rookery. Except for Daphni, all other beaches in the rookery require an average of 3,5 emergences to successfully nest. Annually Daphni holds the lowest nesting success of the rookery, with turtles requiring an average of 6 emergences to nest. On Daphni between 1984-1992, an average of 5 emergences were needed to nest; between 1993-2000, this rose to an average of 6.5 emergences. The data indicates that while Daphni may have already been a difficult beach to nest on, development on the beach in the 1990's appears to have further affected nesting success rates.

The data clearly indicate that turtles 'preferentially' emerged in specific subsectors (i.e. AD, PS, SW). Some subsectors, like A-D held high emergence rates but low nesting success in 2000. Such regions until 2000 held significant numbers of nests, however in 2000 were heavily subjected to human activities. This table also shows that turtles are still emerging in formerly 'preferred' subsectors but with negligible success. A strong positive, negative or neutral correlation was noted between different subsectors, with markedly negative correlations arising in adjacent areas. Nest site location analysis between 1995-2000 revealed a significant shift away from subsectors: AD, OP, QR. The data clearly indicate that turtles, over subsequent years have started nesting in new areas, including DE, GI, TW; in other words areas of beach which to date have received the least disturbance.

### SUGGESTED MANAGEMENT METHODS FOR DAPHNI BEACH

To date, Daphni has fallen under the protection of several National Government Presidential Decrees. The formation of the National Marine Park should ensure that current legislation is enforced. It is suggested that the following environmental factors are monitored annually to establish and re-adjust management measures on Daphni:

- Develop programmes to monitor and control fire, grazing, trampling etc.
- Develop programmes to assist natural regeneration of affected land.
- Management of surface erosion to decrease the level erosion and land slides.
- Monitor effects of eroded material deposition on the beach.
  - o Maintain erosion control works of the 2 roads leading to Daphni.
  - o Continual re-assessment of vegetation cover of the beach & perimeter: beach front shape (at sea and vegetation line), beach profiles, clay and silt content, sediment inflow and outflow of the beach, dune system and land.
- Expansion of scientific monitoring and conservation. orientated research of the flora and fauna; in the hills, dunes, beach and surrounding reefs.
- Continual assessment of sea turtles: number of nests, nest distribution, nesting success, incubation time and hatching success

and to define the boundaries of breeding aggregations.

- Public awareness & education liaison initiatives to involve the locals and alter their impact on the beach.
- Implement night curfew (7pm- 7am) as required by the NMPZ and ensure effective wardening.
- Implement effective beach cleaning so as not to lose nest sites.

#### *Acknowledgements:*

The authors thank the ARCHELON volunteers who have helped to compile the information for Daphni. We thank the David and Lucile Packard Foundation and the Sea Turtle Symposium for travel support.

#### LITERATURE CITED

- Katselidis K. & D. Dimopoulos. 1999. The impact of tourist development on loggerhead nesting at Daphni beach, Zakynthos, Greece. Proceedings of the 18th Annual Workshop on Sea Turtle Biology & Conservation. NOAA Technical Memorandum NMFS SEFSC. pp.93-95.
- Witherington, B.E. 1999. Reducing threats to nesting habitat. In Eckert, K.L., K.A. Bjorndal, F.A. Abreu-Grobois & M. Donnelly (Editors). 1999. Research and Management Techniques for the Conservation of Sea Turtles. IUCN/SSC Marine Turtle Specialist Group Publication No. 4. Pp179-183.