

## Influence of tide variations on the emergences of *Caretta caretta* on the Island of Boavista (Cape Verde, West Africa)

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### INTRODUCTION

The island of Boavista (Republic of Cape Verde, Western Africa) is located in front of Senegal (Fig. 1). Here we find one of the most important nesting colonies of *Caretta caretta* in North Atlantic Ocean (López-Jurado and Andreu 1998). Reproduction biology of this population is been a part of a conservation effort since 1998. Although the relationship between tides and emergences of sea turtles follows a pattern that depends on several factors as the slope of the beach (Frazer 1983, Le Buff 1990) we have tried to determine, as a preliminary approach, if the emergences of loggerheads in Boavista are influenced by the tidal stage, independently of the slope of the beach.

### MATERIALS AND METHODS

Along 2001 nesting season, 1045 female loggerheads were sighted emerging from the sea for nesting during night patrols in the southeastern beaches of Ervatão and Ponta Cosme. Apart from data relative to other studies (biometry, clutch size and others) the time of emergence of each female was annotated. Data on tidal stages used in this work were provided by the Instituto Hidrográfico Português (IHP 2001). The major port in Cape Verde archipelago is Porto Grande, located in the island of São Vicente (16°50' N, 25°00' W) so data were converted to establish the corresponding value for Boavista. On the other hand we categorized arbitrarily the tidal cycle in four stages of three hours each (based on Frazer 1983): low (minimum amplitude), rising (intertidal stage from minimum to maximum), high (maximum amplitude), and falling (intertidal stage from maximum to minimum).

### RESULTS

In Fig. 2 we can see the total number of emergences, and the minimum and maximum levels of the sea during the whole nesting season. A high percentage of females emerge when the dead tides begin or finish. We used the period from 5th August to 3rd September to evaluate the possible influences of the tides in female emergences covering a moon cycle. The great number of turtles emerging from the sea occurs when the tide is high ( $X^2=14.705$ ,  $df=3$ ,  $p=0.002$ ; see Table I and Fig. 3). Also the same patterns of emergences is observed in the two different beaches studies, emerging the females mostly on high tide (Table 1).

### DISCUSSION

Although further studies must be done in Boavista concerning the influence of tides in female loggerhead emergences (attending factors as slope of the beaches, light intensity and others), as a general trend the results of this work shows us how female loggerheads in Boavista emerge preferably when the tide is high or rising. This agrees with Frazer (1983), working in beaches with a gently slope. We have not measure the slope of our beaches, but at first sight, they appear to have considerably distance between low and high tide lines. As other authors suggest (Carr 1952, Frazer 1983, Le Buff 1990) when the tide is high the distance a turtle travels to find the nest site is lower, with less expenditure of energy.

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Table 1. Number of emergences of *Caretta caretta* during 2001 season in Boavista by the four tidal stages established in the three beaches studied.

Tidal stage	Ervatão	Ponta Cosme	Total
Low	30	37	67
Rising	42	58	100
High	66	65	131
Falling	45	44	89
Total	183	204	387



Fig. 1. Map showing the location of the Cape Verde archipelago and Boavista.

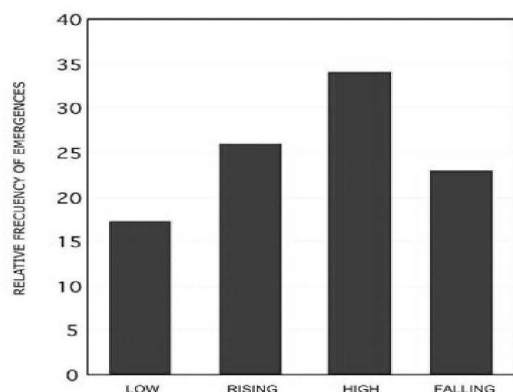


Fig. 2. Distribution of the emergences of *Caretta caretta* in Boavista during the 2001 nesting season and amplitude of the tides along the summer.

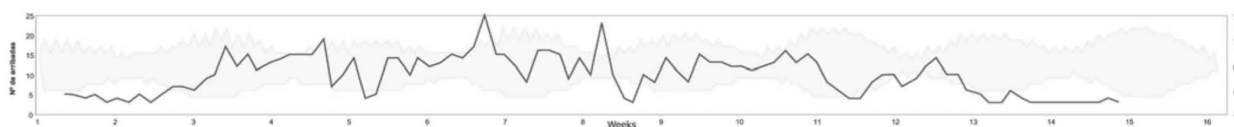


Fig. 3. Distribution of the emergences of *Caretta caretta* during 2001 season in Boavista by the four tidal stages established.

## Disorientation of the green turtle, *Chelonia mydas*, during nesting exercise relative to some physical and human factors at Ras Al-Hadd Reserve, Oman

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### INTRODUCTION

The mechanism of orientation relative to sea finding in sea turtles, especially in hatchlings has been studied under different experiments relative to light cues, wavelength, light angle and light intensity (Mrosovsky and Kingsmill 1985, Witherington and Bjorndal 1991a, 1991b, Witherington 1992, Lohmann et al. 1997). Many of the disorientation studies on hatchlings can also be related to adult turtles. For example, the use of artificial light during nesting can cause disorientation in adult turtles and also sea-finding behavior which is guided by light cues (Witherington and Martin 1996).

A five-year survey was conducted on the green turtles, *Chelonia mydas*, became disoriented while performing their nesting exercise, and consequently, were stranded on the beaches. The green sea turtles in Oman nest year-round, with a high density nesting period between June and October and low density period between November and May. The purpose of this study is to investigate the causes of disorientation in the nesting turtles at specific selected sites at Ras Al Hadd Reserve.

### METHODS

**Study Area.** Ras Al-Hadd Reserve is a 45 km coastal strip on the Gulf of Oman and the Arabian Sea, with over 20 major beaches that extend from Al-Jarama Bay to Ras Ar Ruays (see Map 1). It is located between 22° 14'N and 22° 32'N and 59° 45'E and 59° 48' E. The majority of these beaches are isolated at the back and sides by rocky hills, with a crescent shape configuration. As a result, each beach is completely separated from the

adjacent beaches. The dimensions of the major beaches ranges between 1.0-7.0 km shoreline length and 50-100 m in width, while the minor beaches have dimensions of 50-100 by 10-40 m. However, the turtles only use an area of about 50 m from the tidal zone for nesting. The beaches have deep and open sandy offshore approaches, which are free of submerged rocks except in a few areas. Most of the beaches consist of soft sand with gentle slopes (0.5-5.0 m), free of rocks or major barriers, and with sparse or no vegetation. The beaches are exposed to moderate or high energy wave action. The four selected sites are: Site 1. Is called Ras Al-Jinz, surrounded by rocky hills on back and sides of the beach. The back hills are about 100-150 m from the tide zone. The site is about 1 km where the shoreline is divided by rocky hills in the middle separating the site into north and south sectors. The depth of the nesting area is between 30 and 50 m. Commercial fishing is limited to the south sector and only during November to April. Site 2. Is also called Saih Al-Marai, and like site 1, is well isolated by hills. The depth of the nesting area is 50 m. Sites 3 and 4. These sites have unsheltered beaches, without any hills in back or sides of the beaches. The beaches slope gently from the shorelines and in certain areas, there are steep slopes toward the land sides obscuring the sea horizon completely from the turtle view. The vegetation is sparse or lacking. The shoreline length of both sites extends for 6.90 km and an average depth of 50 m nesting area. Commercial fishing is year-round and extensive.

**Procedures.** The disoriented turtles were collected around sunrise before temperature rises. A team of rangers from Ras Al-Hadd Reserve drove their vehicles on roads leading from the Reserve to pick up live or dead stranded turtles. The paired test