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REGRESSION/PROGRESSION OF FIBROPAPILLOMA SEVERITY IN GREEN TURTLES IN THE INDIAN RIVER LAGOON, FLORIDA, BASED ON RECAPTURE RECORDS

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Between January 1998 and December 2000, we captured 41 previously tagged green turtles. Changes in GTFP status were examined by comparing photographs and/or tumor drawings of initial captures with those from subsequent captures. There was no change of GTFP status if the recapture period was less than 10 months.

Of 17 individuals without GTFP at initial capture, 11 (64.7%) remained unaffected at subsequent recapture over more than a 10 month period. Six of 17 (35.3%) non-GTFP turtles at first capture were afflicted with the disease by the second capture. Of 24 green turtles with FP at the first capture, 21(87.5%) showed clear regression or complete absence of GTFP by the second capture. None of the turtles that showed regression of GTFP tumors was severely afflicted at the first capture (76%=mildly afflicted, 24%=moderately afflicted). Three out of 24 (12.5%) green turtles with FP tumors present at the first capture showed progression in the severity of GTFP. The longest recapture record (4 years) was observed in an individual which showed mild affliction at the first capture and absence of GTFP at the second capture. No turtle classified as severely afflicted has been recaptured more than 7 months after the initial capture. This may indicate reduced survivorship in the most severely afflicted animals.

EVIDENCE FOR BEHAVIOURAL EFFECTS ON DAILY PROFILES OF MELATONIN AND CORTICOSTERONE IN MARINE TURTLES

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In addition to biophysical cues such as light and temperature, the circadian system of vertebrates may be regulated by non-photic cues such as behaviour. This influence of behaviour on the circadian system can be assessed by measuring the response curve of particular circadian rhythms including hormone cycles. In this study we examined the effect of induced and spontaneous nocturnal behaviours on the daily profiles of the melatonin (M) and corticosterone (B) cycle in captive and wild green turtles, *Chelonia mydas*. First, we examined if captive juvenile turtles exhibited the predicted nocturnal and diurnal profiles in plasma M and B. Second, low- and high- intensity nocturnal behaviours were induced in captive turtles to ascertain any effect of behaviour on hormone profiles of M and B. Third, the effect of three spontaneous nocturnal behaviours- nesting, mate searching by males and feeding/swimming in wild turtles were investigated to determine the effects of natural behaviours on the expression of circadian hormone cycles. In captive turtles, a distinct nocturnal and diurnal profile in M and B was expressed. Induced and spontaneous field based nocturnal behaviour caused a marked decrease in nocturnal levels of plasma melatonin compared to inactive turtles. Nocturnal behaviour prevented the nocturnal decrease in corticosterone. Our findings provide evidence for an association between daily profile variation in melatonin and corticosterone and various nocturnal behavior in green turtles.

LOGGERHEAD NEST SITE FIXITY IN THE ROOKERY OF LAGANAS BAY, ZAKYNTHOS, GREECE

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INTRODUCTION

Researchers have found that (loggerhead and green) sea turtles are 80% faithful to particular rookeries (Kikokawa, 1999), 70% faithful to 3 km clusters of beaches (Mortimer & Portier, 1989) and 71% faithful to their 1st nesting beach of the season (Wang & Cheng, 1999). This means that about 30% of turtles move between different beaches. Nest site fixity is assessed by calculating how close turtles nest to their previous nesting site. This study primarily assesses nest site fixity of loggerhead turtles to a particular beach in the rookery of Laganas Bay in one season, and degree of exchange between the six nesting beaches. Secondly, nest site fixity is assessed with respect to one beach, the high-density nesting beach of Sekania.

THE STUDY SITE

Zakynthos (37.38°N x 20.37°E) is one of the Greek islands situated in the Ionian Sea in the Mediterranean. The island is 406 km^2 with 155 km of coastline. Laganas Bay, in the South East of the island, is 20 km in length with a 12 km opening, and constitutes part of the National Marine Park of Zakynthos. The Bay holds a highly important loggerhead sea turtle rookery consisting of 6 discrete nesting beaches totalling about 6 km in length. This rookery can hold up to 2018 nests per year (Margaritoulis, 2000). Nesting density ranges from 55 nests per km (East Laganas) to more than 1000 nests per km (Sekania) (ARCHELON data). Five of the beaches occur at irregular intervals along the coastline of the Bay, and are separated by rugged promontories. The 6th beach is on Marathonissi, one of 2 islets occurring in the Bay. Each of the 6 beaches ranges in length, orientation, wave action, beach slope, vegetation cover, sand sorting co-efficient, sand colour and content, and human disturbance (light, noise, habitation).

METHODOLOGY

ARCHELON, the Sea Turtle Protection Society of Greece has been monitoring systemically all 6 nesting beaches in Laganas Bay since 1984. The nesting activity is determined by morning surveys. In addition turtles were tagged throughout every night during the 2000 nesting season (June 1st- July 31st) on four of the beaches. All turtles encountered nesting, with one or no tags, were tagged with "Rototags" on the front flippers. All turtles camouflaging or returning to the sea were checked for existing tags on all four flippers and the tag number(s) recorded. In addition, the subsector location of every observed emerging and nesting turtle was recorded.

Data were collected during 2000 on the precision of nest site fixity of loggerhead turtles within the Bay with respect to three types of re-nesting emergence patterns: a) following abandoned nesting attempts in 2000; b) after intervals separating consecutive egg clutches in 2000; c) after remigration intervals of one or more years. Re-emergences within 2000 were also examined in the degree of nest site fixity between 10-20 metre subsectors located on the beach of Sekania. 'Neophyte' and 'remigrant' turtles were also compared. Neophytes were distinguished as being newly tagged turtles with no previous scars or tags on any of their four flippers. The inter-seasonal re-migratory data covered a period from 1993-2000 and was obtained from the ARCHELON archive.

RESULTS

The data shows the degree of nest site fixity of 132 tagged individual turtles recorded emerging on the nesting beaches more than 2 times during the 2000 nesting season. An important finding was that re-migrants were never recorded using more than 2 nesting beaches, whereas neophytes were recorded using up to 3 nesting beaches. The data shows turtle exchange rates between nesting beaches within the rookery, during the 2000 season. There is a flow of turtles moving away from Sekania to alternative nesting beaches, which occurred primarily in the 2nd 3 weeks of June, after the first nesting flux. The data indicate that the beaches to which most turtles are moving to is Laganas and secondly Gerakas.

Additional analysis of nesting exchange between beaches across consecutive seasons strongly indicated that adjacent beaches expressed positive exchange correlations. Certain beaches have negative nesting relationships with other nesting beaches within the rookery, i.e. when Marathonisi has an increase in nesting numbers Gerakas will have a decrease, and vice versa. The data suggests that between seasons there is a movement of turtles to Sekania, and from Laganas - which produces a surprisingly inverse trend to that observed within one season.

Nest fixity data trends can be linked to trends in the nesting density figures for the overall rookery. Between 1984-2000 the nesting density has remained stable within the rookery. But for 5 of the beaches within the rookery nesting density is either increasing or decreasing, yet that of Sekania remained on a plateau (ARCHELON data).

Annually, an average of 54% of nests in the rookery are located on Sekania beach, which is one of the densest loggerhead nesting beaches in the world. However, data collected over the last 6 years indicate, no matter what the volume of nests, the majority of emergences and successful nesting attempts occur within the same specific range of beach each year. Sekania beach is physically divided into two main sectors: East and West. East Sekania (365 m) with a clear offshore approach, holds 65% of all nests laid on Sekania annually. 65% of nests laid on East occur on just one third of this sector, in 3 distinct 'clusters'. An inverse correlation to nesting density and hatching success rate was recorded. West Sekania (276 m), fronted by underwater reefs, and holds 35% of nests on Sekania. Regions of both sectors of Sekania beach receive very low emergence numbers and very low nesting numbers, yet inter-seasonal beach exchange shows turtles moving to nest on Sekania, while intra-seasonal beach exchange shows that 15% of turtles in 2000 moved to alternative nesting beaches within the rookery. In 2000, nest site fixity was assessed for 98 turtles recorded emerging on more than 2 occasions on Sekania beach. Table 5 shows that both neophytes and re-migrants "appear" selective, with respect to the sectors (East vs. West), where failed emergences occur (60% & 80% respectively). Both neophytes and re-migrants seem less selective about where they eventually nest (53% & 46% respectively). 50% of the turtles emerged only on one sector (East or West). Of these, all turtles showed nest site fixity within a range of 2 to 14 poles (median 7) around specific subsectors of the beach (out of a total of 26 poles on each sector) (Figure 1). The figure shows that emergences appeared to be random within this range for both neophytes and re-migrants, i.e. turtles were as likely to emerge within a 2 pole range as they are within a 14 pole range around specific subsectors of the beach, but never in a greater range. This supported by daily morning survey data that clearly indicated that areas of each sector are 'preferred' for emergences. Furthermore a positive correlation was observed for subsectors of beach showing greater emergence rates with areas of greater nesting success.

Laganas Bay rookery displayed an average of 84% nest site fixity to specific beaches in 2000 nesting season. In addition, of the 84% of turtles that remain faithful to a particular beach, 50% expressed nest site fixity to within a specific region of beach. The information collected demonstrates that the nesting population in Laganas Bay depend on all six beaches existing as in interconnecting network. Mass tourism has already led to the loss of about 2 of the 8 kilometres of the original nesting beach. For Zakynthos all nesting beaches are now protected, however this is not happening worldwide. It is therefore essential to investigate why and which turtles move between beaches, and what factors influence these turtles to select one beach over another. The mechanisms for beach selection must be linked to nest site fixity and hence nest site selection processes. Is beach exchange and nest site fixity connected to the individual turtle, environmental cues or as a result of anthropogenic pressure?

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LIFE THROUGH LEATHERBACK EYES

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We used new remote video imaging technology to record at-sea behaviour and diving of eight female leatherback turtles nesting at Parque Nacional Las Baulas, Costa Rica. The "Crittercam" camera system simultaneously recorded up to 6 hours of video from the turtle's point-of-view and 12 hours of dive profile data. Our objectives were to obtain visual information on the undersea environment, to observe any feeding behaviour, to determine if social interactions took place, and to measure the frequency and duration of dives.

We used a suction cup to attach the camera to the female turtle's carapace, with the camera mounted between the longitudinal ridges. The suction cup was released from the turtle by means of a small magnesium nut that corroded at a predictable rate and allowed water to enter and release the suction. The camera housing was positively buoyant and contained a VHF transmitter to permit recovery of the camera at sea.

We successfully deployed and recovered the camera on eight occasions, with deployment times ranging from 4 to 12 hours. Most cameras were recovered within 10 kilometres of the nesting beach, with one camera recovered approximately 20 kilometres offshore. Study turtles returned to nest after the camera recovery and there were no observable marks on the carapace caused by the suction cup. Dive profile data showed that the turtles made short, shallow dives for the first few hours after leaving the nesting beach, with dive duration ranging from 15 seconds to 10 minutes. Thereafter the dives became deeper and longer, to a maximum depth and duration of 50 metres and 35 minutes. Dive patterns were consistent between turtles. Surface intervals were typically around 30 to 60 seconds, with the turtle taking two or three breaths during that time.

The undersea environment appeared relatively barren, with few areas of vegetation or coral. Some soft corals were observed, but the majority of the bottom was sandy and with no observable plant life. We did not observe any obvious feeding behaviour, although several turtles showed movements of the head that suggested drinking of seawater, presumably to rehydrate after spending time nesting.

The most startling result we obtained was the frequent observation of male turtles interacting with the study females in what appeared to be attempted mating behaviour. Sex of the turtles was determined by relative tail length. Male leatherbacks had never previously been observed near nesting beaches. Three of eight females were observed to interact with males, one female interacted with three separate males over a two hour period. It appeared that females actively attempted to avoid males, and they were observed to swim rapidly to the bottom and remain motionless when seeing a male. Male turtles circled and attempted to copulate with females, but it appeared that these attempts were unsuccessful because of the body position adopted by the female. Interactions were very physical, with males frequently striking females with the body or front flipper. Interactions typically lasted 15 to 20 minutes, during which time the turtles did not surface to breathe.

Our main conclusions were:

1) There are distinct phases in dive and swim behaviour that change with proximity to the nesting beach, 2) Female turtles do not appear to feed in the 12 hours after nesting, either through choice or because of a lack of suitable prey, 3) The sea floor within 20 kilometres of the nesting beach is relatively barren and does not contain much variety of animal or plant life, 4) Male turtles are present near the nesting beach and attempt to mate with females after nesting. The presence of these males had never previously been suspected and this result profoundly changed our understanding of the mating and migration of leatherback turtles. We infer that male turtles migrate from remote locations and hence are potentially exposed to the same risks during migration as female turtles. The attempted mating of males with already reproductive females suggests that the mating system of leatherbacks may be more complex than previously believed.