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BEACH VEGETATION AND SEAFINDING ORIENTATION OF TURTLE HATCHLINGS

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Abstract

In Suriname, leatherback Dermochelys coriacea *and green* Chelonia mydas *sea turtle eggs laid below the high tide line are routinely relocated to safer ground by local conservation workers. Some of these nests are placed in dense vegetation. The nocturnal seafinding behaviour of leatherback and green sea turtle hatchlings in the vegetation was compared to that in the open beach. Groups of hatchlings of each species were tested in one of two orientation arenas: open sand or dense vegetation. In both species, those tested in the open arenas oriented strongly towards the ocean. Turtles placed in the vegetation either showed no significant orientation or oriented away from the ocean. Animals in the vegetation moved more slowly from the center to the perimeter of the arena. Implications for relocation as a conservation tool are discussed.*

Keywords: Dermochelys coriacea, Chelonia mydas, sea turtle, orientation, turtle conservation.

INTRODUCTION

When sea turtle hatchlings emerge from a nest at night, they immediately move toward the ocean. This seaward orientation is guided by visual cues: sea turtles tend to move away from dark silhouettes and towards the brightest area along a horizon (Mrosovsky & Shettleworth, 1968, 1974; Salmon *et al.*, 1992). On the beach, this corresponds to moving away from the treeline and towards the open horizon over water.

Green *Chelonia mydas* and leatherback *Dermochelys coriacea* sea turtles often share the same nesting beaches, as is the case at Matapica, Suriname. These animals lay a substantial percentage of their nests below the spring high tide line where they are likely to be washed away: about 32% for leatherbacks (Mrosovsky, 1989) and about 25% for greens (Mrosovsky *et al.*, 1984). As part of Suriname's conservation programme, these doomed nests are relocated to beach sites above the spring high tide line, even though relocation often reduces hatching success (Schulz, 1975; Limpus *et al.*, 1979; Eckert & Eckert, 1990; but see Whitmore & Dutton, 1985). Moving doomed eggs is a simple way to increase overall hatchling production on this beach.

In 1993, conservation workers succeeded in transplanting most doomed nests higher up the beach into areas of dense low-lying vegetation. This boosted the proportion of neonates that emerged in vegetation, as typically only a small percentage of natural green and leatherback nests are laid in this area: 13% and 0% respectively (Whitmore & Dutton, 1985).

To assess what effects this nest relocation procedure may have on their seafinding behaviour, we studied the ability of hatchlings to orient towards the ocean when surrounded by vegetation.

MATERIALS AND METHODS

Experiments were carried out from 21 July to 10 September 1993 on a beach in Suriname running east–west between 1 and 8 km west of the Matapica Canal. The beach is located on a sand spit which drifts west at the rate of about 2 km per year (Schulz, 1975), and is separated from the coastal mangrove forest by a brackish lagoon. The width of the spit is approximately 75 m. Above the high water line there is a strip of open sand about 8 m wide. Beyond this is an area of dense vegetation consisting mainly of *Ipomea pescaprae* and *Canavalia maritima* (Fig. 1).

Two orientation arenas were used, each consisting of a circular trench 6 m in radius, dug 40 cm deep and 20 cm wide and divided into 18 equal segments by small sheet metal barriers. Segment 1 was the most seaward, and other segments followed in numerical order clockwise. Both arenas were built in the vegetation and were equidistant from the ocean, but one had all vegetation cleared from its center and from the sand north of it (Fig. 1). The centers of the arenas were approximately 16 m from the spring high tide line, and separated from each other by about 40 m. Within the arenas the ocean was not visible at hatchling eye level.

We gathered naïve hatchlings from natural nests that had been marked after laying and had wire traps placed over them 4–5 days before expected emergence.

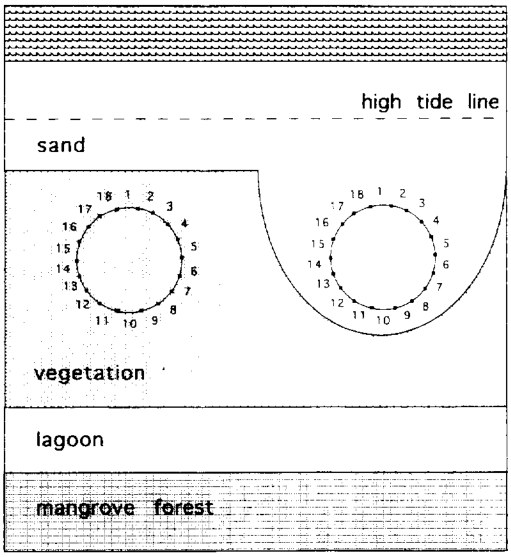

Fig. 1. Diagram of the orientation arenas used in this study. The radii of the arenas are 6 m. The centers of the arenas are separated by approximately 40 m. Arena segment numbers are indicated. The arenas are located in a typical section of beach at Matapica, Suriname.

The traps were checked each morning and turtles were collected and kept indoors in covered plastic buckets until that night, when the experiments were performed.

Experiments took place 2–3 h after sundown. The hatchlings were kept outdoors uncovered for at least 1 h before any tests were run, to ensure that they would be adapted to ambient light. Each experiment consisted of quickly placing equal numbers of hatchlings in the center of both arenas, and then allowing them to move in any direction until they fell into the trench. During tests we remained seated at a distance (at least 20 m) from the two arenas to avoid interfering with hatchling orientation. At the end of each test the trenches were checked, and the number of hatchlings in each segment and those remaining in the arena (if any) were recorded. The turtles were then released on the berm from where they proceeded toward the ocean. The position of the moon, if visible, relative to the arenas was recorded for each run.

Only one species was tested at any one time. Preliminary tests, in which hatchlings were placed in the center of the vegetation arena with a bright light shining from segment 1 (most seaward), showed that green turtle hatchlings needed between 15 and 25 min to reach the trench, whereas leatherbacks needed around 45 min. Because leatherback turtles moved more slowly, the duration of each run was different depending on the species tested. Green turtle hatchlings were deposited in the middle of the two arenas simultaneously, and were allowed 30 min to move about. Leatherback turtles in the vegetation arena were given 60 min, while those tested in the open arena were tested for only 30 min, timed to coincide with the second half of the vegetation arena run. The test time of the leatherbacks in the open arena was cut to reduce exposure to ghost crabs *Ocypode quadrata*.

Rayleigh's test (Zar, 1984) was used to check for significant orientation within each group of animals. When both groups in a pair showed significant orientation, Watson's U^2 test (Zar, 1984) was used to look for differences in direction.

RESULTS

We tested four paired groups of leatherback and green turtle hatchlings (summarized in Figs 2 and 3). We

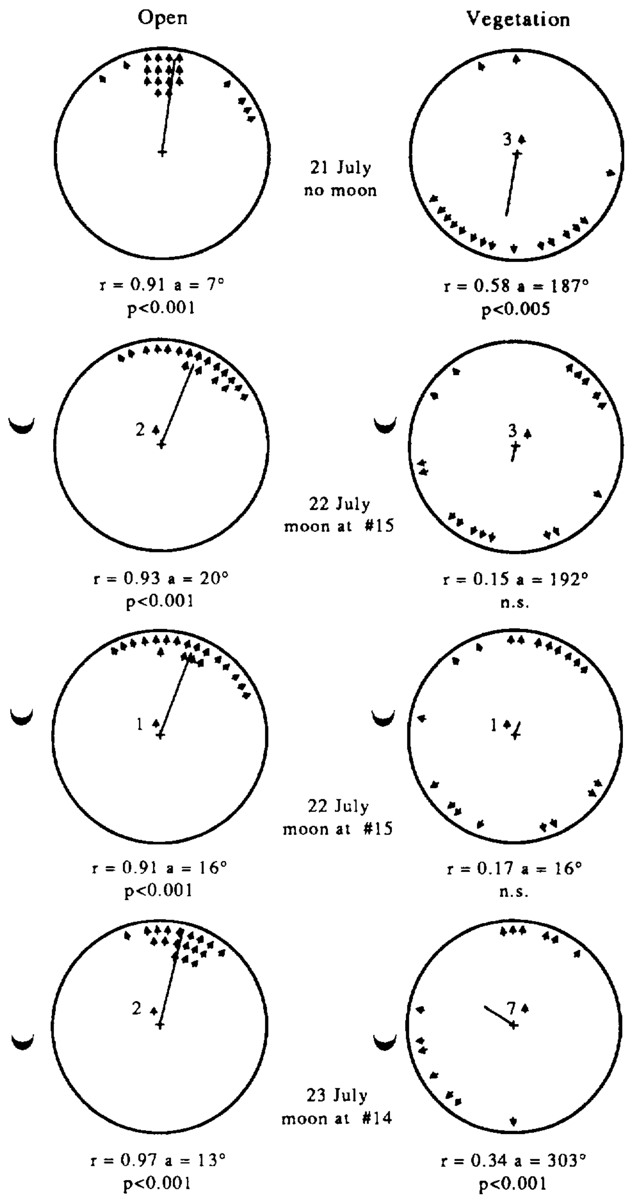

Fig. 2. The results of the orientation experiments on green turtle hatchlings. Each row represents two groups tested at the same time in the open and vegetation arenas. If the moon was visible at the time of testing, a moon symbol indicates its direction. Each turtle icon represents an individual tested and final location at the end of the trial. The number in the center of the arena represents the turtles remaining there at the end of the test. Mean angle of dispersion of each group is indicated by the line originating at the middle of the circle, where 0° is defined as the middle of segment 1 (most seaward). Line length is inversely proportional to dispersion; lines reaching the perimeter of the circle correspond to r = 1. The r-vector (r), group mean angle (a), and significance of orientation (*p* value) were calculated by the Rayleigh test.

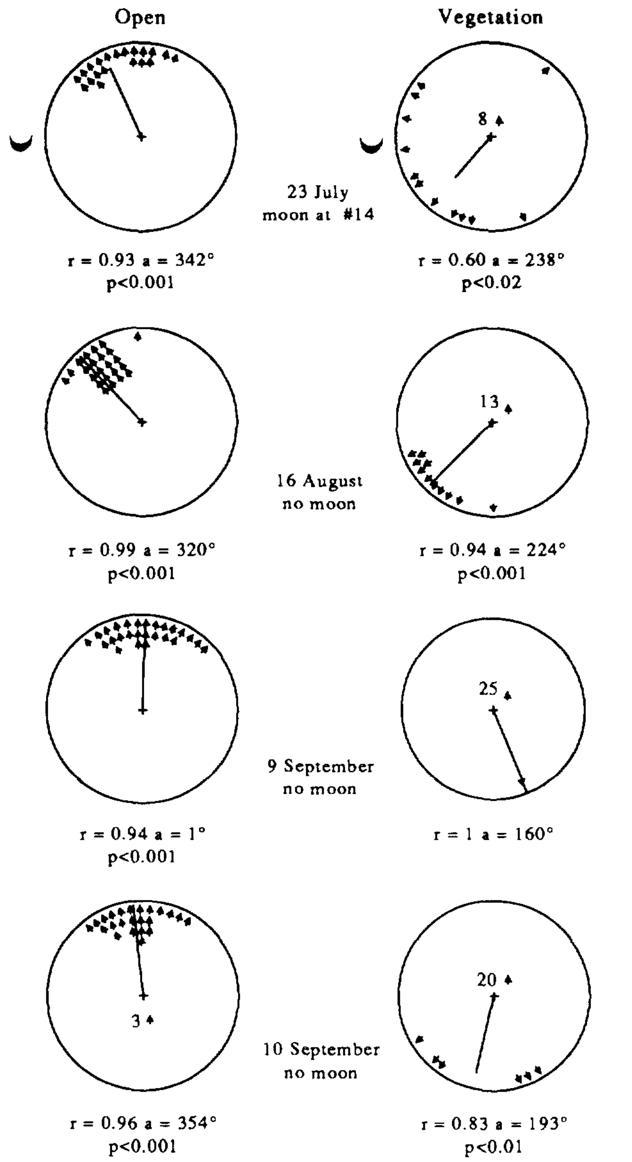

Fig. 3. The results of the orientation experiments on leatherback hatchlings. Conventions are the same as in Fig. 2.

observed a clear difference in orientation between all animals tested in the open sand arena and in the vegetation arena. Animals in the open arena showed a strong seaward orientation. Animals in the vegetation arena were more evenly distributed around the circumference, and their orientation was rarely significant. When the Rayleigh test did show significant orientation by the hatchlings tested in the vegetation, it tended to be landward. In these cases the Watson U^2 test revealed that the direction was different from that of the hatchlings in the open arena ($p < 0.001$ in all instances).

Open sand and vegetation sites also differed in the time needed by the hatchlings to reach the arena trenches, evidenced by the numbers of hatchlings that remained in the center. In the vegetation arena, 18% of the greens and 69% of the leatherbacks failed to reach the perimeter, whereas only 6% and 3% remained in the center of the open arena (Figs 2 and 3).

DISCUSSION

There was a difference in the seafinding of the hatchlings tested in the open sand and vegetation. In the open arena, both green and leatherback turtles oriented towards the sea, although there appears to be a slight difference in direction between the species (also observed by Mrosovsky and Shettleworth, 1975). When placed in dense vegetation, hatchlings tended to scatter rather than orient towards the ocean. Dense vegetation presumably obscured the visual cues normally used for seafinding, specifically silhouettes along the horizon and photic gradients (Mrosovsky & Shettleworth, 1968, 1974; Salmon *et al.*, 1992). The former corresponds to the mangrove forest treeline, and the latter to the brighter sky above the ocean (Fig. 1). At turtle eye level the beach vegetation created a visually homogeneous environment where the usual orientation cues were absent.

In some cases, hatchlings confronted with uniform vegetation oriented away from the ocean (Figs 2 and 3). This landward orientation might be explained by the use of slope cues in the absence of adequate photic information. Salmon *et al.* (1992) found that loggerhead hatchlings oriented down inclines, though this response was weakened in the presence of even very dim light. The beach at Matapica slopes down on either side of the high water line thus in both arenas, segment 1 was at a higher elevation than segment 10. It is interesting to note that this landward orientation was strongest on moonless nights, when ambient light levels were lowest.

Animals in the vegetation arena took longer to reach the trench, particularly leatherbacks, the majority of which remained in the arena after each test was finished. This may be because the hatchlings became entangled in the vegetation, but this is not likely to be the only cause. Disorientation played the major role: preliminary tests using an artificial light source demonstrated that even in dense vegetation leatherback hatchlings were able to reach the arena trench in about 45 min. Had the animals been able to orient properly, the testing interval would have allowed ample time for turtles to reach the trench. The greater mobility of green hatchlings in vegetation may be attributable to a species difference in sampling for orientation cues (Mrosovsky & Shettleworth, 1975). This could be tested further in a similar study of hawksbill hatchlings, as they frequently nest in vegetation (Witzell, 1983). This may reveal the principal orientation cues hawksbills make use of in finding the sea.

Regardless of the causes and mechanisms responsible, these results show that the seaward movements of green and especially leatherback turtles are hampered when nests are in dense vegetation. Because these animals spend more time on the beach, their exposure to predators increases, and there is the added threat of desiccation for a hatchling remaining on the beach after sunrise. On several different occasions we noticed stray hatchlings in the middle of the day wandering through the vegetation near our field camp some 70 m from the spring high tide line. It is probable that some hatchlings that emerge in the vegetation never reach the sea. Thus, published hatch rates of relocated nests may not reflect the proportion of hatchlings that are actually added to the population, if a significant number of nests are reburied in vegetation.

Nevertheless, these results should not be taken as an argument against nest relocation as an effective conservation tool. Rather, this study serves as a means to refine this technique. Caution is needed in selecting relocation sites. Where the doomed eggs are placed is important, not just their removal from the tidal zone.

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