Potential changing environmental parameters influence the nesting behaviour of leatherback turtles

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INTRODUCTION

Several studies have strongly suggested climate change effects in life history processes from animals, such as breeding. Reproductive events, among other processes, are likely guided by climate. Marine turtle females wait offshore for the optimal conditions before nesting once they arrive to their natal areas, but these environmental cues keep being mostly unknown.

GLMM	GLM
Wind direction as random factor	Wind direction as fixed factor
Rainfall High tide Low tide	Rainfall High tide Low tide
Barometric pressure	Barometric pressure Wind speed

Table 1. Results for binomial GLMM and GLM, with nests and aborted attempts as response variables. Factors with negative influence shown in red, factors positively correlated shown in green.

RESULTS AND DISCUSSION

Nesting showed certain degree of negative correlation with rainfall and both low and high tides, whereas correlation with wind speed and barometric pressure was positive (table 1).

Influence from wind in nesting was rather low, not appearing in all selected models, and wind direction only diminished it's influence in the models. Other influencing factors were high and low tides, with negative correlation in both the GLMM and GLM. Some studies suggest that positive correlation with high tides are found in seashores with diurnal tides, where tidal range is very wide (Frazer, 1983), unlike our study site, where other tide-related factors could be causing negative correlation to nesting.

Nests and aborted attempts were not completely correlated, what suggested that some nights were more suitable for nesting than others. Barometric pressure was only included in the aborted nesting attempt model with a negative correlation, thus enhancing nesting. Rain and both high and low tides were included in the model for nests with negative influence (table 2). Other hypothesis suggest that turtles could follow different cues when emerging from the sea and when performing nest site selection (Wood and Bjorndal, 2000; Pike, 2008), either environmental, as our results showed, or abrupt changes in beach physical characteristics, like some other studies have found (Godley et al., 2001; Weishampel et al., 2003; Mazaris et al., 2006; Rivas et al., 2016b).

Our data supported the idea that rough weather could discourage nesting (fig.1a,1b), since rain was negatively correlated with nests and especially because the highest values for rainfall were clearly related to low nesting values.

CONCLUSIONS

Our results show that the highest loads of rainfall discourage turtle nesting. High and low tides are also dissuading nesting, suggesting that turtles notice when tidal cycles reach their extremes and avoid their effects.

Climatic features likely related to storm episodes such as heavy rainfall, change in wind patterns and extreme tidal ranges may influence leatherbacks' nesting behaviour. Therefore, and taking into account the increase in both frequency and intensity of storm episodes in tropical areas since the 1990s (Goldenberg et al., 2001; Patino-Martinez et al., 2014), we could suggest that it will negatively affect leatherbacks' nesting activity, what could eventually represent an additional obstacle to the survival of this threatened species.

Table 2. Results for GLM with nests and aborted attempts as response variables, separately. Factors with negative influence shown in red, factors positively correlated shown in green.

GLM NESTS	GLM ABORTED ATTEMPTS
Rainfall High tide Low tide	Barometric pressure Wind speed
Landward wind Seaward wind Sea surface temp. Wind speed	Landward wind Seaward wind Sea surface temp.

AIMS

1) Distinguish the factors driving leatherback turtle nesting in order to understand the effect that climate change may produce over this biological process.

2) Study the differences between factors favouring nesting and those causing aborted nesting attempts.

METHODS

The 5.7 km long beach at the Pacuare Reserve, in the Caribbean Costa Rica, was monitored from 2010 to 2015. Patrols covered the beach during all night, registering both nest and aborted attempts.

Environmental data including maximum and minimum temperatures, rainfall, wind speed, direction, and barometric pressure was provided by the National Meteorological Institute (IMN) from Costa Rica. High and low tide data was given by CIMAR from Costa Rica and sea surface temperature from the National Centre for Ocean Forecasting (NCOF), using both satellite data and in-situ observations.

Binomial GLMM and GLM, with both nests and aborted attempts as response variables, were run to find factors driving nesting, taking wind direction as a fixed factor in the GLM. Regarding the study of differences between nesting and aborted attempts, GLM were run for each response variable separately.

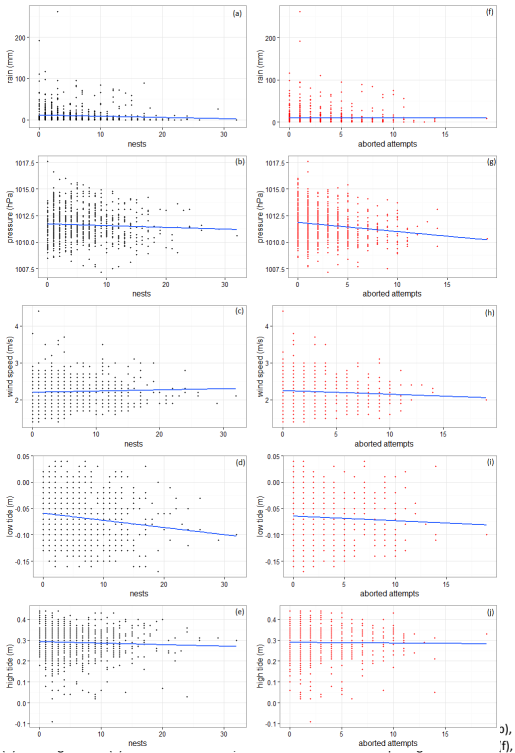

Figure 1. Regr), wind speed (c), low tides f), barometric pressure (g), wind speed (h), low tides (i) and high tides (j).

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