Potential effects of extreme climatic events resulting in prolonged precipitation on reproductive output of sea turtles

Marga L. Rivas [1,2] , Manuel Spínola [3], Michel Faife[4]

[1] Nature & Oceans of the Americas

[2] University of Granada

[3] International Institute in Conservation and wildlife management. University Nacional, Costa Rica

[4] Botanical garden. University of Central "Marta Abreu de las Villas", Cuba

Introduction

Climate change by potential anthropogenic origin is predicted to increase variations in storm patterns and precipitation in some areas and to decline in others. These variations in mean rainfall and increase in mean temperature could increase extinction risk of temperature-dependent sex determination species. Taking into account that sea turtle reproductive output depends on climatic conditions, such as precipitation (Houghton et al., 2007; Wyneken and Lolabar, 2015) and temperature (Santidrian et al., 2012, 2015; Pike et al., 2015), extreme climatic events might affect mortality of eggs and hatchlings. Our main goal was to assess the effect of extreme climatic events, as prolonged precipitation episodes, on the reproductive output of leatherback turtles, (*Dermochelys coriacea),* and how changing climatic events might reduce hatchling production and consequently, threaten sea turtle populations.

Figure 1. The location of Pacuare Nature Reserve and Limón on the Caribbean coast of Costa Rica

Methods

To study how short periods of protracted rainfall affect sea turtle reproduction output we recorded (i) hatching success of n = 48 nests located at 50, 75 and 90 cm depth under sun and shading treatment from 2013 to 2015 at the Pacuare Reserve, in Caribbean Costa Rica, (ii) sand moisture at 10, 25, 50, 75 and 100 cm depth, and (iii) water table level from 2013 to 2015. In addition, we assessed changes in seasonal precipitation, nest abundance and annual hatching success of leatherbacks over time.

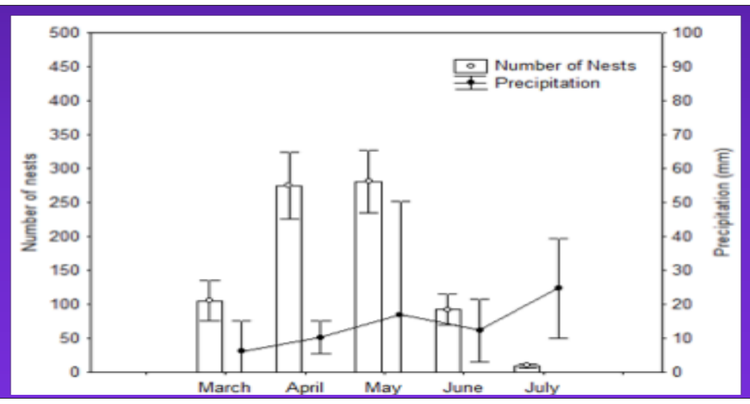
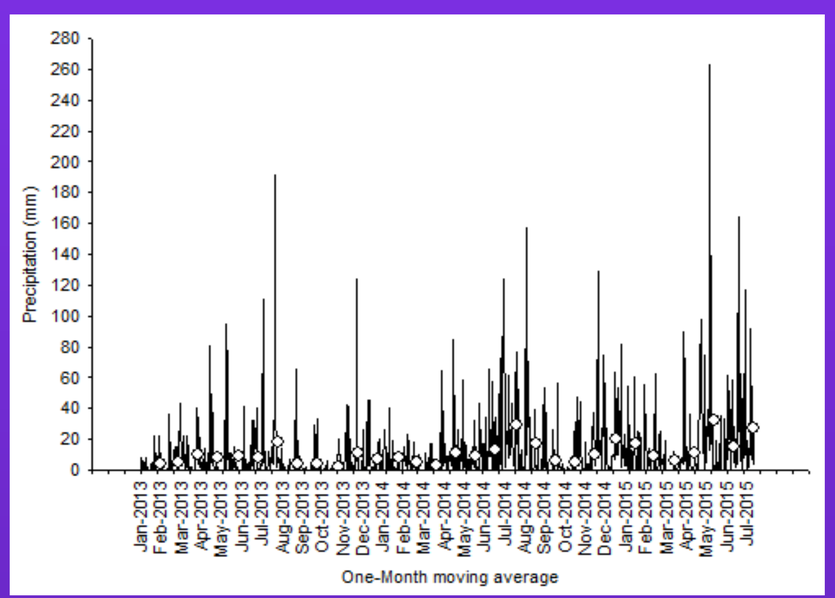


Figure 2. Number of nests oviposited by leatherback turtles (*Dermochelys* coriacea) from 2000 to 2015 and precipitation (mm) recorded during 2013-2015. The centre point in the box represents the mean value; the whiskers represent confidence interval.



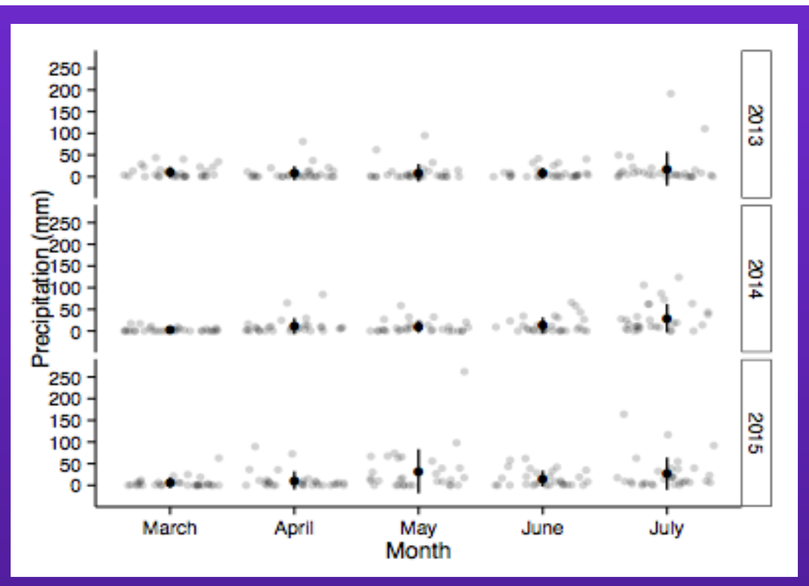


Figure 3. A. Mean monthly precipitation (mm) in the Caribbean region of Costa Rica from 2013 to 2015. Data was smoothed with a One-Month moving average and are represented in white points. **B**. Measurements of precipitation (mm) recorded by month during 2013-2015. The centre point in the box represents the mean value; the whiskers represent confidence interval.

Results

The results showed that changing climatic conditions as prolonged precipitation (Fig. 3) significantly influenced hatching success (Fig. 4). Protracted rainfall raised water table levels and increased the levels of sand moisture (Fig. 5), which consequently increased egg mortality of deeper nests (Fig. 4) .

Discussion

Leatherback reproductive output was affected by protracted precipitation, by decreasing hatching success. These effects may be higher considering the expected increase in storm frequency projections. Thus, the assessment of the effects of these extreme events on nesting grounds is necessary to predict potential extinction risk of sea turtle populations.

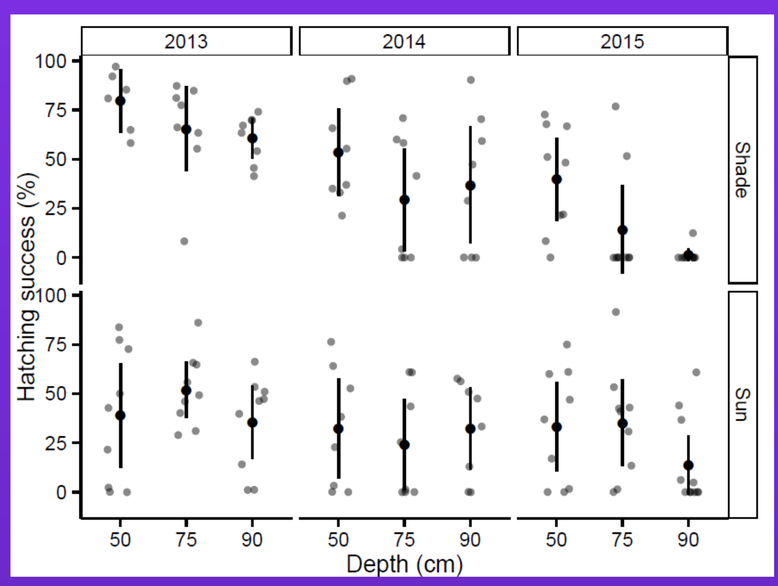
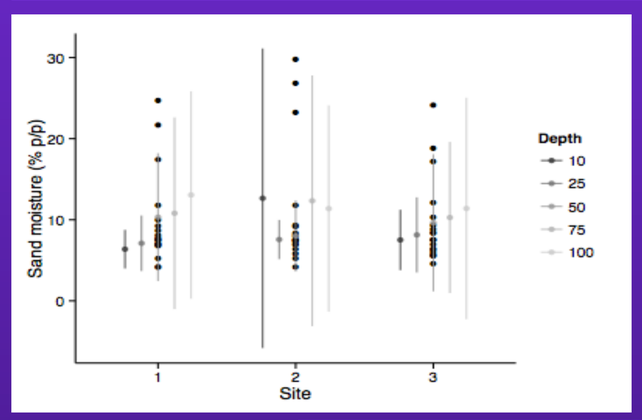


Figure 4. A. Hatching success (%) of leatherback nests under sun and shading treatments and depth (50, 75 and 90 cm) in 2013, 2014 and 2015. The centre point in the box represents the mean value; the whiskers represent confidence interval.



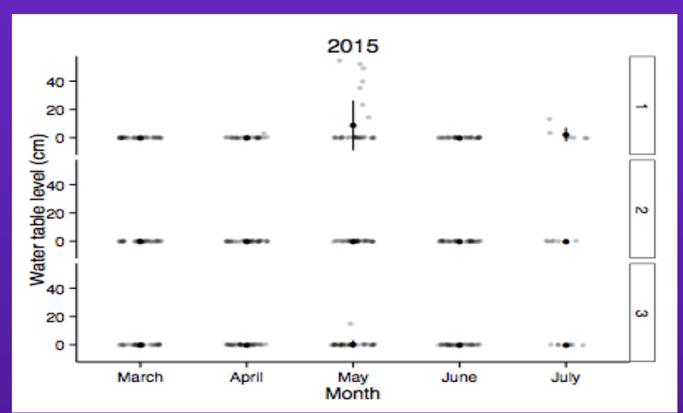


Figure 5. A. Sand moisture (% p/p) recorded in Pacuare Nature Reserve in three sites 1, 2 and 3 at 10, 25, 50, 75, 100 cm depth in April, May, June and July in 2015. The centre point in the box represents the mean value; the whiskers represent confidence interval. **B.** Water table level measurements (cm) recorded once a week at site 1, 2 and 3 in March, April, May, June and July in 2015.