Large-scale investment in the excavation and ‘camouflaging’ phases by nesting leatherback turtles (*Dermochelys coriacea*)

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Electronic supplementary material (ESM)

Table S1. Descriptions of nesting phases.

Table S2. Phase durations of leatherback turtle nestings recorded in this study and compared with previously published values.

Figure S1. Changes in breathing intervals during the nesting process of the leatherback turtle.

Figure S2. Pathways taken by female leatherback turtles during sand scattering phase.

References for ESM
Table S1. Descriptions of nesting phases

1. **Approach.** Direct movement from the surf up the beach with a gait in which all four limbs are used simultaneously. The main body of the turtle is not lifted from the sand; front flippers perform a crutching movement while the rear flippers are simultaneously used to propel the body mass forwards (Wyneken 1997).

2. **Prospecting.** ‘Finding an appropriate nest site’. Direct forward movements cease. Attempt(s) at body-pitting are made and then abandoned. Following abandonment the turtle makes significant changes to its orientation or position on the beach before a further attempt to body-pit is made. In this case significant changes to orientation were defined as a greater than 90° rotation on its axis, significant changes to position as movements of the centre of the body a distance greater than approximately 1.5m. A turtle may settle upon the first body-pitting site chosen, in which case this phase does not occur.

3. **Body-pitting.** Turtle ceases to make significant changes in its orientation or position on the beach. Front flippers are used simultaneously in powerful breast-stroke like thrusts to throw sand backwards leading to a build-up of sand behind the front flippers. Rear flippers are used in synchrony in ‘swishing’ side to side motion which act to clear surface sand and flatten the area directly behind the turtle and further enlarge the bank of sand between the front and rear flippers. Front and rear flipper movements happen alternatively. The term ‘body-pitting’ derives from nesting by other species of marine turtle that dig a deep pit before excavating the nest cavity. Leatherbacks do not do this, but instead prepare mounds of sand behind their front flippers as described above, presumably to stabilise them while digging.

4. **Excavation.** Front flipper movements cease. Rear flipper movements change from the synchronised ‘swishing’ action seen during body-pitting to alternate use of the left and right flippers. This is characterised by the flicking of sand to one side then the other, with movements gradually changing as the nest hole deepens.

5. **Laying.** Rear flipper actions cease. Generally a single flipper covers, and may be partially inserted into, the entrance to the nest hole. Egg laying begins and is accompanied by the periodic contraction of the flipper muscles, particularly of the one covering the nest.

6. **Re-Filling.** Rear flipper movements begin with the lifting of the covering flipper from the entrance of the nest hole. The covering flipper is then generally used to push sand from within the sides of the nest hole on top of the eggs. Rear flippers are then used alternatively to push sand into the hole and press it downwards. Stronger compaction actions, where it is evident that significant weight is brought to bear occur with increasing frequency as the phase progresses.

7. **Sand scattering.** This phase is widely termed ‘camouflage’ or ‘disguise’ from the presumption that it functions to disguise the nest site against detection by predators or
parasites. While this seems sensible, there is no evidence for its function so we have here
used the neutral term ‘sand scattering’. Begins with the simultaneous movement of both
front flippers (the first movement of them since the end of body-pitting). The front flippers
are moved in a powerful ‘butterfly stroke’ fashion to throw sand backwards; this action is
generally repeated several times during a movement event. Rear flippers are moved in a
synchronised side to side ‘swishing’ movement (similar to that seen during body-pitting)
which acts to scatter sand. Front and rear flipper movements do not occur at the same time
but may occur in series within the same movement event. Changes in the position and
orientation of the turtle on the beach and periods of complete cessation of all movement
often associated with breathing also occur.

8. Return to the Sea. Direct movement generally towards the sea (although full circles may
occur on the way) using the same gait as observed during the approach phase. No rear or
front flipper scattering actions will be observed. Phase ends when two successive waves
entirely encircle the turtle’s body.
Table S2. Phase durations of leatherback turtle nestings recorded in this study and compared with previously published values. All measurements are in minutes. SD = standard deviation, SE = standard error. *represents the combined approach and return to the sea duration, † estimated overall time.

<table>
<thead>
<tr>
<th>Source</th>
<th>This Study</th>
<th>Reina et al.(2002)</th>
<th>Eckert and Eckert (1985)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behavioural Phase of Nesting</td>
<td>Fishing Pond, Trinidad ± SD</td>
<td>Playa Grande, Costa Rica ± SE</td>
<td>St. Croix, U.S.V.I. ± SD</td>
</tr>
<tr>
<td>Approach</td>
<td>7.4 ± 1.8 (n = 22)</td>
<td>22.0* (n = 23)</td>
<td>8.5 ± 6.5 (n = 23)</td>
</tr>
<tr>
<td>Prospecting</td>
<td>7.9 ± 5.4 (n = 23)</td>
<td>16.5 ± 0.8 (n = 82)</td>
<td>9.4 ± 6.3 (n = 58)</td>
</tr>
<tr>
<td>Body-Pitting</td>
<td>6.2 ± 2.6 (n = 27)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excavation</td>
<td>23.2 ± 7.3 (n = 31)</td>
<td>17.4 ± 0.7 (n = 147)</td>
<td>22.9 ± 8.7 (n = 73)</td>
</tr>
<tr>
<td>Laying</td>
<td>11.0 ± 2.0 (n = 33)</td>
<td>12.7 ± 0.4 (n = 164)</td>
<td>10.8 ± 2.9 (n = 113)</td>
</tr>
<tr>
<td>Re-Filling</td>
<td>11.4 ± 2.2 (n = 33)</td>
<td>47.3 ± 3.6 (n = 173)</td>
<td>34 ± 17.1 (n = 28)</td>
</tr>
<tr>
<td>Sand scattering</td>
<td>28.1 ± 7.8 (n = 33)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Return to the Sea</td>
<td>5.1 ± 1.9 (n = 31)</td>
<td>22.0* (n = 36)</td>
<td>4.2 ± 2.3 (n = 36)</td>
</tr>
<tr>
<td>Entire nesting process</td>
<td>100.7 ± 12.8 (n = 21)</td>
<td>117.8 ± 17.5 (n = 84)</td>
<td>112.6 ± 28.4† (n = 76)</td>
</tr>
</tbody>
</table>
Figure S1A to F. Changes in breathing intervals during the nesting process of the leatherback turtles. Data from all six nestings recorded during the 2012 season.
Figure S2 A to Z. Pathways taken by female leatherback turtles during sand the scattering phase. Field sketches taken as described in Materials and Methods of the main text. A to I are from the 2012 season; solid line, edges of disturbed areas of sand; dashed line, path of turtle before return to the sea; cross, position of nest; circle, last position of female before leaving directly to the sea; arrow, direction to the sea; centroid of disturbed area as indicated; scale bar, 1 metre. J to Z are from the 2014 season in which paths were marked with straight lines between each position at which the turtle stopped to scatter sand; scale bar 80 cm; other indicators are as above.
References

