



A FIELD KEY TO THE DEVELOPMENTAL STAGES OF SEA TURTLES

ANDREA D. PHILLOTT

FLAME University, Pune, Maharashtra, India

andrea.phillott@flame.edu.in

Knowing the stage and time of embryo mortality can help us identify and evaluate management techniques (e.g., the time between nests being laid and reburied in a hatchery) or environmental events (e.g., excessive rainfall, tidal inundation, or high temperatures) during the incubation period that potentially reduced hatching success. Those interested in determining the developmental stage at which sea turtle embryos in their hatchery or on their nesting beach died will find a recent paper published by Jeff Miller, Jeanne Mortimer, and Colin Limpus a useful resource. Published as an open access paper in the journal *Chelonian Conservation and Biology*, Miller *et al.* (2017) present an identification key divided into two parts with illustrations that allow users to stage embryos in the field using only a $\times 10$ hand lens and handheld light.

Sea turtle embryo development has been described in 31 stages, the first five of which occur while eggs are still within the oviduct of the female. Development in the oviduct pauses at the stage of mid-gastrulation. When the eggs are laid, development proceeds from stage 6-31. The key developed by Miller *et al.* (2017) uses external morphological characteristics such as pigmentation of the carapace, position and pigmentation of limbs, appearance of the eyes, yolk volume compared to embryo volume, and measurements of embryonic features to determine embryonic stage. As embryo development in all species of sea turtle is similar, the key can be used to stage all species. The key descriptions are simple and easy to understand, although users might be more familiar with the terms for characteristics of later-stage embryos (e.g., carapace and pigmentation) than early-stage embryos (such as blastopore and somite). However, illustrations with guiding arrows will help even those unfamiliar with embryology to understand the key and make decisions between the two choices at each step appropriately.

Miller *et al.* (2017) remind us that embryos that die at an early stage of incubation are likely to degrade over time, so it can be difficult to find evidence of embryonic

tissue in unhatched eggs that are opened when nests are excavated after hatchlings have emerged from other eggs within the nest. Eggs without a visible embryo should not be automatically categorised as 'infertile'.

Miller, J.D., J.A. Mortimer & C.J. Limpus. 2017. A field key to the developmental stages of marine turtles (Cheloniidae) with notes on the development of *Dermochelys*. *Chelonian Conservation and Biology* 16: 111-122. Available at: <http://www.bioone.org/doi/abs/10.2744/CCB-1261.1>