Research Summaries

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Harewood, A. & Horrocks J. 2008. Impacts of coastal development on hawksbill hatchling survival and swimming success during the initial offshore migration. *Biological Conservation* 141: 394-401.

Coastal development and associated light pollution adjacent to turtle nesting beaches is, or is becoming, an issue in many nations. Since orientation in sea turtle hatchlings was first investigated in the 1960s, the issues surrounding their dispersal and the impact of artificial light have received considerable attention (see review by Lohmann *et al.,* 1997). While much of the attention has been on orientation and light distraction of hatchlings as they crawl down the beach, fewer studies have addressed offshore orientation in response to coastal light pollution. In a recent study, Harewood and Horrocks investigated the swimming behaviour of hatchlings in the first 20 minutes of swimming in relation to various natural and artificial light horizons. Their investigation found that while overall predation rates were low (6.9%) hatchlings released from lighted beaches spent longer swimming within 100 meters of the beach and artificial light and moonlight both played an important role in the ability of hatchlings to escape the inshore waters. Essentially their study, and other similar studies, highlighted that even though hatchlings get to the water, light pollution on adjacent beaches can trap the hatchlings in the shallow inshore waters where predators are often more abundant and trapping them in the inshore zone can cause premature use of yolk stores. The findings of Harewood and Horrock's study are important because they demonstrate that solving light pollution issues is more complex than keeping specific nesting beaches dark and coastal planners should consider creating darkened zones along the coastal fringe or around islands. Further implications of the research could involve predicting and managing shifts in turtle nesting zones with altered beach profiles or locations as a result of climate change impacts.

Fish *et al.* 2008. Construction setback regulations and sea level rise: mitigating sea turtle nesting beach loss. *Ocean and Coastal Management* 51: 330-341.

A critical aspect of turtle management will involve both (1) understanding the impacts of climate change on nesting beaches and (2) how turtles will respond/adapt to changed conditions. Within these two broad areas exists a whole suite of geomorphological, ecological and social factors, and the links between them, that can be explored. Fish and colleagues approached the issue from the point of view of; beach space, turtle nest site use and development restrictions in Barbados. They used standard survey techniques and GIS software to create elevation models for main nesting beaches. They then used IPCC (International Panel on Climate Change) sea level rise predictions to assess the likely impact "loss of beach" under different predictions and different development setback regulations. Setback regulations differ under various local and state legislation but generally dictate how close to the coastline development can occur. The results of the study demonstrated that with changes to sea level patterns the effective development setbacks of 10

and 30m are no longer sufficient to protect the foreshore dune systems, which would have implications for the flora and fauna that depend on them. Fish and colleagues have used an inter-disciplinary approach combining survey techniques with turtle biology to predict the impacts that climate change or development regulations may have on beach/dune systems. This is a powerful tool in the design of mitigation and management and a technique that could easily have broader application in marine turtle nesting beach management.

Hays, G.C. (ed). 2008. Sea turtles: physiological, molecular and behavioural ecology and conservation biology. *Journal of Experimental Marine Biology and Ecology, Special Issue* 356: 1-144

This is a rich period for syntheses and reviews on various aspects related to sea turtle biology and conservation. In the past five years, there have been several scientific books published specifically on sea turtle topics such as: the biology of sea turtles (Lutz *et al.,* 2003), loggerhead turtles (Bolten & Witherington, 2003), ridley turtles (Plotkin, 2007), turtles in the Indian subcontinent (Shanker & Choudhury, 2006), and turtles in the Northeast Atlantic (Lopez-Jurado & Loza, 2007). In addition, there have been special issues of scientific journals dedicated to sea turtles, such as the Kemp's ridley (*Chelonian Conservation and Biology* Vol. 4:4), the leatherback turtle (*Chelonian Conservation and Biology* Vol. 6:1), and marine turtles as flagships (*Maritime Studies* Volumes 3:2 and 4:1). The breadth and depth of topics covered by these various publications is impressive, but there is always room for more reviews and syntheses. Recently, the *Journal of Experimental Marine Biology and Ecology* (or *JEMBE*) published a special double issue (Vol. 356:1-2) on sea turtles, edited by Graeme C. Hays. This compilation of papers is dedicated to subjects related to physiological, molecular and behavioral ecology and conservation biology of marine turtles. The special issue contains six review papers and five original research papers, four of the latter dedicated to in-water behavior as revealed by dataloggers or satellite tags. The other research paper describes a possible link between climate change, specifically increasing ocean temperatures, and reduced reproductive output of Pacific loggerheads. All the research papers are of interest in their own right, but here we focus on the review papers.

Considering the review papers, the subjects are: metabolic rates, genetics, predation of adults, IUCN Red List categories, leatherback research in Gabon and Suriname/French Guiana, and navigation. All should be of interest to anyone who works with sea turtles, although perhaps the paper on leatherback conservation work in two large rookeries in the Atlantic is targeted to a subset of sea turtle workers. Nevertheless, this paper does highlight the challenges associated with establishing standardised protocols for monitoring basic life history parameters and behavior on turtles that tend to nest densely and/or over wide areas. The other reviews are much more general and applicable to all locations, and are also illuminating.

The review on metabolic rates is the first review of its kind, and likely reflects the increasing sophistication of recent studies on physiological processes of sea turtles. This paper describes various metabolic rate values estimated for different species and life stages, and what methods were used. However, the real meat of the review comes in the second half, when values are linked to actual turtle behaviors, such as migration or thermoregulation. There is also an extended section on leatherback thermoregulation, which is fascinatingly complex if still not completely understood phenomenon. The review on genetics or molecular ecology is not the first of its kind (two general reviews were recently published by Bowen & Karl, 2007 and Avise, 2007). However, it does provide a different focus, with emphasis on molecular methods and how they have evolved over time.

There is also an extended discussion on multiple paternity in sea turtles, describing both data and theory related to this interesting reproductive behavior that is apparently common in most species of sea turtle. The review on IUCN Red List categories for sea turtles is somewhat technical but highly readable and provides eye-opening information on the difficulties of classifying

widely distributed taxa (such as sea turtle species) under one category of extinction risk. It should make everyone think carefully about what it means to state that sea turtles are endangered. The review on navigation is an update to earlier reviews (e.g. Lohmann *et al.*, 1999), and it is replete with new information and data. The research on sea turtle navigation is fascinating, especially in the past decade when turtles have been actively manipulated, for example by attaching magnets to their bodies or displacing individuals far away from their original position, and monitored. It may come as a surprise to some that although turtles can use a magnetic field to orient themselves, they also use other cues to navigate.

Overall, the review papers in the special issue of *JEMBE* are rich in information and insight. Ideally, one should read them all, but even if you have time to read only one, go ahead - pick one out and read it. You should find it quite insightful and stimulating, and you will be sure to learn a lot.

Literature cited

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