Research summaries on sea turtles

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Gratiot N., J. Gratiot, L. Kelle, B. de Thoisy. 2006. Estimation of the nesting season of marine turtles from incomplete data: statistical adjustment of a sinusoidal function. *Animal Conservation* 9: 95-102.

Throughout the world many governments, communities and NGOs have established and maintained monitoring programmes for nesting sea turtles. In general, one of the objectives of these programmes is to develop an estimate of annual population size (i.e. the number of females breeding per year) and inter-annual population trends (i.e. variation in the number of breeding females over years). However, obtaining estimates of the population size is difficult because it is often too expensive, or logistically not possible, to conduct beach surveys for each night during a nesting season that may run for many months. The difficult question in these cases is how often and how long is monitoring required to provide accurate estimates of population size.

Gratiot and colleagues have addressed this pertinent question by conducting statistical modeling on datasets collected from two species nesting in French Guiana. In both species nesting occurred for several months of the year with a distinct mid season peak that lasts one to two months. Their two main findings were (1) that estimates of total annual population size based on various intervals of continuous nesting beach surveys were most accurate when surveys of ~50 days in length were conducted and (2) if continuous nesting beach surveys can not be conducted over the peak of the season, or if it is not possible to conduct continuous monitoring, then data collected during 30 days of monitoring conducted randomly throughout the nesting season can be used to provide a reasonable estimate of annual population size.

It is refreshing to see mathematical approaches being taken to try and strengthen the ability of data sets collected at nesting beaches to detect population trends. This will ultimately improve the ability of management agencies to define monitoring objectives and monitoring programs that are complementary. The challenge now will be to develop this or similar methods for other species, populations and rookeries that have year round or bi-modal nesting; and test their applicability in assessing previously collected datasets.

Koch V., W.J. Nichols, H. Peckham, V. de la Toba. 2006. Estimates of sea turtle mortality from poaching and bycatch in Bahia Magdalena, Baja California Sur, Mexico. *Biological Conservation* 128: 327-334.

There are two populations of loggerhead turtles in the Pacific Ocean; southwestern Pacific (e.g. Australia) and northwestern Pacific (e.g. Japan). Both these populations of loggerhead turtles have undergone well documented declines over the last one to two decades. Over the last decade it has emerged that the waters of the eastern Pacific are important nursery or juvenile habitats, and the mid oceanic waters are important foraging and migratory habitats for loggerhead turtles that breed in the eastern Pacific. A crucial aspect that needs to be addressed to enable the successful implementation of management practices to help stem declines in nesting numbers in both the southern and northern Pacific is to identify and quantify threats.

Koch and colleagues have addressed this by quantifying sea turtle mortality in Bahia Magdalena Bay in Baja California. They report close to 2000 dead turtles in three years; mostly loggerhead (44%) and green [black] turtles (37%) and these were a combination of beach washed carcasses with no known cause of death and animals caught in nets for consumption. This translates to an annual minimum mortality rate of around 250 loggerhead turtles in this small geographic area of Baja alone. Although genetic work was not presented it is likely that these turtles are mostly from the northern Pacific nesting population. The authors highlight that irrespective of any unrecorded mortality in other areas in Baja, the mortality rates indicated in their study combined with other published data on mortality from high sea long lines or coastal gillnets are likely to hinder the effectiveness of long term conservation work on the nesting beaches in Japan.

In the Southeast Asian region bycatch of marine turtles occurs in the trawling and gillnet fisheries of many countries. In addition, most southeast Asian sea turtle conservation projects, while acknowledging off-shore mortality, have focused on nesting beach protection. Without the quantification of offshore, or indeed overseas, mortality of sea turtles, management of nesting populations will remain problematic. The data presented by Koch and colleagues will certainly aid in the development of management programs for loggerhead turtles within the Pacific Ocean .

Broderick, A. C., R. Frauenstein, F. Glen, G. C. Hays, A. L. Jackson, T. Pelembe, G. D. Ruxton, and B. J. Godley. 2006. Are green turtles globally endangered? *Global Ecology and Biogeography* 15: 21-26.

Sea turtles are endangered. Or are they? The answer to this question depends on several things, including: a) the definition of the term endangered and b) the geographic scale that is being considered. The World Conservation Union (also known as IUCN) publishes the Red List of endangered species that provides information on the risk of extinction of different species, based on a clear set of criteria (see www.redlist.org for more information). The Red List assessments are done on a global scale. In the case of sea turtles, six species have been assigned "endangered" or "critically endangered" status by the Red List. The exception is the flatback turtle that is designated as "data-deficient" because not enough historical data are available for proper assessment. In 2004, the global status of the green sea turtle was assessed and determined to be "endangered" according to Red List criteria. By definition, "endangered" means that the global population of green turtles has declined by more than 50% in the last three generations of turtles (calculated as 106-150 years – see www.iucn-mtsg.org/red_list for more details).

What if you consider green turtles at a regional rather than global scale? That is the subject of the recent publication by Annette Broderick and her co-authors. They present data on green turtle nests from Ascension Island, which is located in the middle of the Atlantic Ocean. Central to their argument, they show that although the island's green turtle population suffered a decline that was related to intensive harvesting of females between the early 1800s and the early 1900s, in the last several decades this green turtle nesting population has been growing at an exponential rate with an expected reduction in the rate of growth. The nesting population of Ascension Island is now nearly as big as it was estimated to be in the early 1800s – thus it would not qualify as "endangered" if it were assessed independently. However, an assessment based on one population also has associated problems; to counter this Broderick and her co-authors point out that Ascension Island is not the only green turtle rookery in the Atlantic for which data show an increasing numbers of nests laid. In particular, the large populations in Tortuguero (Costa Rica), Bijagos (Guinea Bissau), Yucutan (Mexico), Suriname, and Florida (USA) are all increasing. I would add to the list Trindade Island (Brazil) and western French Guiana where there is no evidence of a decrease over the past few decades or based on historical data. It is important to note that there are a few places in the Atlantic Ocean were nesting numbers have declined in recent years, including Aves Island (Venezuela) and Bioko (Equatorial Guinea), but overall the largest rookeries are stable or increasing. As a result, Broderick and her colleagues suggest that the Red List status of sea turtles be assessed on a regional scale, and in the case of the Atlantic Ocean green turtles should not be listed as "endangered."

One might ask why this matters. In particular, some people have argued that having sea turtles listed as "endangered" or "critically endangered," regardless of the Red List criteria, can only help sea turtles and sea turtle conservation, so there is no reason to alter the Red List status of any sea turtle populations. The issue boils down to credibility. A primary purpose of the Red List (and its categories of "endangered" and "critically endangered") is to provide a relative index of likelihood of extinction. If all green turtles in the world are listed as endangered (as they currently are), then all nesting populations should receive equal effort in protection and conservation actions. However, there are some places in the world where green turtle populations are declining, and they should receive more attention and effort than those that are increasing. For instance, the green turtle nesting population in Michoacán (Pacific Mexico) has greatly declined in recent decades and deserves a high level of concern and effort in conservation actions, relative to the population at Ascension Island. Yet, the current global classification by the Red List does not distinguish between these two nesting populations in terms of risk of extinction. For these reasons, Broderick and others have called for a change in the current system of assigning Red List status; specifically they recommend that regional assessments (as opposed to global assessments) be pursued, as a means to more adequately focus conservation activities on those populations that greatly need it.

Taquet, C., M. Taquet, T. Dempster, M. Soria, S. Ciccione, D. Roos, and L. Dagorn. 2006. Foraging of the green sea turtle *Chelonia mydas* on seagrass beds at Mayotte Island (Indian Ocean), determined by acoustic transmitters. *Marine Ecology-Progress Series* 306: 295-302.

Green turtles are largely herbivorous, eating either seagrasses or algae as juveniles and adults. However, relatively little is known about their foraging or other in-water habits given the logistic difficulty in observing sea turtles in the water. Recent technological advances in tracking devices such as satellite tags are helping to describe previously unknown migration patterns between nesting and foraging areas. Yet, there are limitations to satellite tags. For instance, the location information is usually only collected when the turtles are at the surface of the ocean while breathing. Also, many locations derived from the satellite tags have a large range of error associated with them, making it difficult to pinpoint exactly where the turtles are or have been. Another commonly used method is sonic telemetry. This involves attaching a small transmitter to the turtle and then, unlike satellite telemetry. a hand held receiver is used to detect signals and locate turtles while they are underwater. Traditionally this method has been used to pinpoint the exact location of turtles at sea. One drawback of sonic transmitters and the use of hand held receivers to detect turtles is that their effective range is relatively short (less than 1000m). This has meant that researchers usually have to patrol zones continuously to detect and then pinpoint where the tagged turtles are and observe what they are doing. This kind of direct observation may have an impact on the turtles themselves, if researchers are forced to bring their boats or swim in the water nearby the turtles in order to study them.

In the publication above, Taquet and her colleagues describe how they attached sonic tags to green turtles and used a novel system involving an underwater grid of stationary sonic receivers to remotely monitor their activities in and around a seagrass bed in Mayotte. In this way, they were able to monitor several turtles at a single time while eliminating the possibility of altering the behaviour of the turtles due to the presence of the researchers nearby. After 31 days of monitoring, it was found that the green turtles (adults and a single large juvenile) largely foraged during daylight hours, although some also foraged at night when there was sufficient moonlight available to illuminate the seagrass bed. The researchers also found that the turtles tended to favour a certain part of the seagrass bed.

This study contributes to increasing our understanding of in-water behavior of sea turtles and also provides a novel method for remotely monitoring their small-scale movements. It is likely that in the future, new technological advances will facilitate the study of detailed in-water behavior. In the meantime, the monitoring system described by Taquet and collaborators will likely inspire other researchers to pursue similar studies of turtles elsewhere.