measures. Their review highlights the challenges of understanding and managing bycatch in small scale fisheries and describes several methods that can be used by both gill net and pound net fisheries to mitigate bycatch without impacting catch rates of target species. Importantly, however, the authors also highlight the need to undertake cost-benefit risk assessments to understand population specific impacts from bycatch mortality and in doing so provide details of the information needed to permit realistic risk based assessments.

Taken together, the two bycatch studies above highlight the significance of the collective impact of coastal artisanal and net based fisheries on marine turtles are. Further, they highlight the need for an inter-disciplinary approach, including engaging the fishing industry, to design and apply cost effective mechanisms to understand and manage bycatch of marine wildlife species.

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Better estimating how many clutches females lay in a season

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Tucker, A.D. 2010. Nest site fidelity and clutch frequency of loggerhead turtles are better elucidated by satellite telemetry than by nocturnal tagging efforts: Implications for stock estimation. Journal of Experimental Marine Biology and Ecology 383: 48-55.

How many clutches does an individual sea turtle lay in a nesting season? It is a simple question to ask, but not simple to accurately answer. Of course, we know that individual turtles lay several clutches during a single nesting season, but discovering the exact clutch frequency (number of nests laid in a season) is logistically challenging. Traditionally, the tried-and-true method for determining clutch frequency has been to conduct "saturation" tagging projects, where patrollers monitor a nesting beach all night, every night, during the nesting season, in order to find and record all individual turtles nesting on the beach. However, datasets from nighttime beach monitoring usually have at least a few gaps in information, because a) some turtles nested before or after the monitoring project was active; b) some turtles nested on a non-monitored beach near (or even far) from the monitored beach; c) some turtles emerged, nested and returned before the patrollers saw her; etc. Thus, a tagging project may be able to calculate the "Observed Clutch Frequency" (OCF) for the turtles in the study area, but most sea turtle researchers see OCF as an underestimate (e.g. Reina *et al.*, 2002). Many workers have applied a correction factor to the OCF.

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Researchers at Casey Key beach, including Tony Tucker who authored the article above, have been placing satellite tags on nesting loggerhead sea turtles for several years, to study postnesting migrations (Girard *et al.*, 2009). They also have used the satellite tags to count how many clutches individual turtles have laid during the nesting season. This was possible because the satellite tags were placed on the turtles early in the nesting season – presumably during the first time the turtles emerged to nest on Casey Key. Then, the researchers were able to watch for patterns in the satellite tag data for subsequent nesting emergences made by the females: essentially, when a turtle with a satellite tag nests, the tag sends repeated high-accuracy locations from up on the beach. At Casey Key, the beach patrollers often were able to verify the satellite data because they saw the turtles on the beach during subsequent nest emergences. In addition, there were nests made by turtles that the patrollers did not see, often (but not only) when the turtles chose to nest on beaches different from Casey Key. In the end, the mean clutch frequency derived from satellite tag information was 5.4 clutches/turtle, vs. the mean clutch frequency of 2.2 clutches/turtle calculated only from night patrol data.

The difference is not academic, it in fact has major management and conservation importance, precisely because most places count the overall number of clutches (nests) observed, but not the number of individual females laying the clutches. Thus, to calculate population size and to assess population trends, it is necessary to divide clutch totals by average clutch frequency, to get the number of females. The number of females calculated this way is sensitive to differences in clutch frequency, as Tony Tucker discussed eloquently over two decades ago (Tucker, 1989). Clearly, he has been thinking about this issue for many years! It is interesting that this information breakthrough was facilitated by technology (satellite tags); there were other fascinating kinds of information produced during this study, including confirmation that one turtle was able to lay two clutches of eggs only six days apart.

Of course, more studies like this one will be needed to ensure that an accurate value for clutch frequency is assigned to each nesting beach or aggregation. In addition, it is also possible that average clutch frequency for a rookery can change over time. For instance, larger females may lay more clutches than smaller females (e.g. Tucker & Frazer, 1991), and if the nesting population has an increased percentage of larger females over time, the clutch frequency may also change. Also, regional environmental factors can have profound implications on the average reproductive output of females (e.g. Saba *et al.*, 2008).

Overall, it is likely that clutch frequency changes over time. This also has implications for assessing trends in turtle nesting, if nothing else than to rule out the possibility that an observed increase or decrease in clutch numbers over a short period is due solely to

changes in clutch frequency rather than to changes in absolute numbers of reproductive females. In the end, the Casey Key study has set a benchmark for future research on sea turtles, and reminds us why it is so important to have accurate measures of basic life history measures.

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Report

30th Annual Symposium on Sea Turtle Biology and Conservation 24 - 30 April, 2010, Goa, India

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For the first time in 30 years, the International Sea Turtle Society's Annual Symposium was held in south Asia, a region home to globally significant populations of marine turtles, and a diverse range of organisations, community based groups and institutions involved in sea turtle research and conservation. The symposium provided an excellent opportunity to participants from countries in South and Southeast Asia underrepresented in previous symposia to attend the event.

The theme of the symposium '*the world of turtles*' drew attention to the wide range of ecosystems that sea turtles inhabit including coastal, nearshore and oceanic ecosystems, from sandy beaches to coral reefs and seagrass meadows, and pelagic habitats. An important focus of the symposium was also to draw attention to the human communities that sea turtles interact with, in particular resource dependent coastal fishing communities.

With over 500 participants from over 60 countries, the success of the symposium was reflected in the coming together of ideas in research and lessons in