Long term monitoring data reveal a size decline in loggerhead turtles nesting in South Africa

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Background

Although sea turtle populations have exhibited signs of recovery since nesting beach protection efforts, long term monitoring (> 30 years) allows identifying underlying trends otherwise non-detectable, which may be essential in evaluating the effectiveness of management strategies. Loggerhead (Caretta caretta) and leatherback (Dermochelys coriacea) turtles nesting in South Africa have been continuously monitored since 1963, representing one of the longest running sea turtle beach monitoring program in the world (> 55 years). These previously depleted population are believed to be recovering as illustrated by increased nest numbers and proportion of first time nesters (neophytes) in the nesting cohort. However, there might be evidence that the individual size of nesting females has decreased over time and based on the assumption that smaller turtles have smaller reproductive output and fitness, we question whether first time nester size is decreasing and if that could affect current and future reproductive output and ultimately population growth, despite an apparent increasing population. The present study thus aimed to assess temporal trends in female size of loggerhead turtles nesting in South Africa during the 35 year period 1980-2015.

Methods

All nesting data were collected by the provincial conservation authority Ezemvelo KZN Wildlife in accordance with their legislated conservation mandate. Daily night patrols were conducted on foot and trained observers recorded the date, species, carapace size (straight carapace length: SCLmin: from anterior nuchal notch to posterior notch), straight carapace width (SCW: widest points) for loggerheads, and curved carapace length and width (CCL, CCW) for leatherbacks. A 35-year time series (1980-2015) of nesting beach survey was used to assess trends in neophyte and remigrant turtle sizes over time for both species using linear models.

Results

Loggerhead neophyte mean SCL (± SD) varied from of 873.5 ± 42.01 to 846.3 ± 32.34 mm (range 620-998 mm, n = 7518) from 1980 to 2015, indicating a 27.2 mm decrease in size. The linear model showed a significant 1.35 mm decline in mean neophyte size which equates to 47.2 mm over the 35 years period (-1.35 mm per year, p < 0.0001). Mean CCL (± SD) varied from of 1615.0 ± 87.05 to 1599.5 ± 126.14 mm (range 765-2075 mm, n = 2970) from 1969 to 2015 for leatherbacks and the linear model showed a non-significant stable trend in mean size over the 35 years period (p < 1.00, R² = -0.00034).
Conclusion

While loggerhead turtles in South Africa are a conservation success story and the population is growing, the study revealed that nesting females are decreasing in size by 2.7 cm over the past 35 year. Such a decline represents a significant change for a long-lived, slow-maturing species such as loggerhead turtles, especially considering growth rates declining with increased body size, and little or no growth following maturation. Thus, despite 54 years of conservation efforts the decline in individual female size indicates that threats are occurring outside nesting grounds. This could suggest that South African turtles may be responding to an environment with limited resources by maturing sooner and diverting energy from growth and maintenance to reproduction. Although we could not determine the specific reasons for this decrease in size, we speculate that this decline may be driven by a decrease in ocean productivity due to climate change or by bycatch in fishery (removing larger size classes). Since body size is also directly correlated to reproductive output in sea turtles, smaller females may have lower reproductive potential which may affect hatchling fitness, survival and ultimately population growth. The study shows that protecting females on nesting grounds is not enough to guaranty population growth if survival is not ensured at subsequent life stages at sea (Crouse et al., 1987; Crowder et al., 1994; Chaloupka & Limpus, 2001; Bjorndal et al., 2005; Margaritoulis, 2005; Mazaris et al., 2006).