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COMMENT

# Tracking turtles to their death

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In a recent study Chaloupka et al. (2004) use data from satellite tags to infer the relative mortality rate of turtles captured by longlines in the Pacific and then subsequently released. They criticise a previous study (Hays et al. 2003), where we proposed the utility of satellite tracking for inferring mortality rates of turtles, following studies that had pioneered this approach with migrating birds (Combreau et al. 2001). Chaloupka et al. (2004) appear to have misunderstood some key points from our paper. This could have important ramifications for turtle conservation efforts; we think it is important to clarify these various issues. Chaloupka et al. (2004, p. 292) criticise our approach by saying:

> The Hays et al. (2003) study (…) used transmitter failure as the basis for assigning a death to a particular turtle, failed to determine cause-specific failure for all transmitter failures and assumed all failures were due to turtle death…

We never used transmitter failure to infer mortality of turtles. Indeed we specifically stated (Hays et al. 2003, p. 307):

> …it is clearly important to be able to identify when a tracked individual has died. It has been suggested that simply the loss of transmissions from a satellite-tracked individual may provide some index of the level of mortality (Polovina et al. 2000). While this approach may be of some use in identifying differences in mortality levels between different groups of animals, it is likely to overestimate the absolute levels of mortality, as satellite transmitters cease to transmit for many other reasons than simply mortality of the tracked individuals (Plotkin 1998).
>
> It is more informative if data relayed via a satellite system can specifically indicate mortality. For example, Combreau et al. (2001) used several criteria, including temperature and activity data relayed via transmitters, to ascertain mortality of satellite-tracked houbaru bustards. Similarly our approach involved the temporal pattern of locations, Argos location class and on-board submergence data to identify mortality events. In most cases, this approach is inevitably inferential, since direct reports of dead turtles are rare. Indeed, if all the turtles killed by humans were reported, then there would be no need to use satellite telemetry to estimate mortality rates.

To reiterate, we used the data relayed by *fully functioning* transmitters to infer that mortality had occurred. These data included: (1) the quality of locations sent by transmitters, (2) location data showing transmitters had moved inland, (3) submergence data showing the transmitter was out of the water.

The example in Fig. 1 shows the nature of this data for a loggerhead turtle *Caretta caretta* tracked as she moved northwards along the east African coast. After gradually moving northwards while the turtle repeatedly dived (indicated by the transmitter's salt water switch), this transmitter came out of the water and moved to a site onshore. The most likely explanation for these data is that the turtle had been captured and taken to a village. This inference was supported by several follow-up studies during which we received reports (e.g. from tourists) of the death of the tracked turtles. The important point is that data relayed via satellite systems can be used to infer mortality of turtles.

Chaloupka et al. (2004) conclude (p. 292):

> …the global annual mortality probability estimate of 0.31 of all sea turtle species exposed to fisheries that was proposed by Hays et al. (2003) is highly questionable at best.

However, Chaloupka et al. (2004) have again misinterpreted the aims of our study. In fact we stated (Hays et al. 2003, p. 308):

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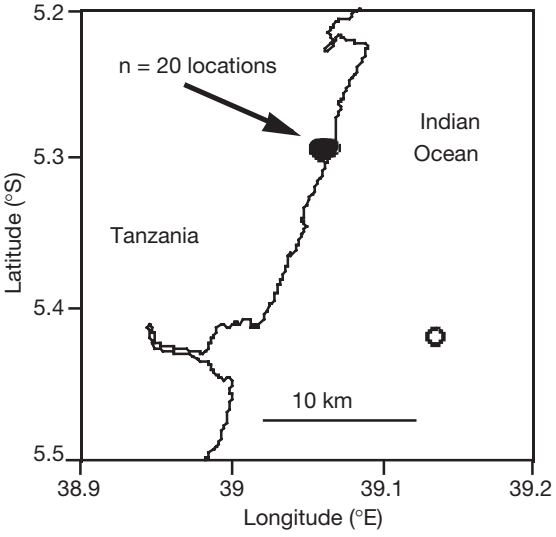


Fig. 1. Satellite tracking results for a South African loggerhead turtle fitted with a satellite tag. This turtle travelled several hundred kilometers up the East African coast until the transmitter came out of the water on 22 July 1998 and moved into the town of Pongwe, Tanzania, where it remained. We surmise that this turtle was captured in the morning on 22 July. Open symbol shows the last location at sea; filled symbol shows the locations in Pongwe after the saltwater switch indicated that the transmitter was out of the water

We therefore do not suggest that an annual mortality rate of 0.31 applies universally across regions and species. Rather, our main aims with this study are to introduce the concept of using satellite telemetry to identify mortality in sea turtles; to show, in the most general of ways, that mortality rates for this group are high; and finally to find a way forward for collaboration between different research groups, so that regional and species-specific mortality estimates can be derived from satellite tracking studies.

To reiterate, we fully appreciate that the sample size in our original study was small and our results tentative, and we explicitly highlighted these points in our paper. The key objective of our manuscript was to alert scientists and conservationists to how satellite tracking can be used to infer mortality in turtles, and to urge scientists to collaborate in obtaining larger sample sizes for accurate estimates of turtle mortality.

*Editorial responsibility: Otto Kinne (Editor), Oldendorf/Luhe, Germany*

## LITERATURE CITED

Chaloupka M, Parker D, Balazs G (2004) Modelling post-release mortality of loggerhead sea turtles exposed to the Hawaii-based pelagic longline fishery. Mar Ecol Prog Ser 280:285–293

Hays GC, Broderick AC, Godley BJ, Luschi P, Nichols WJ (2003) Satellite telemetry suggests high levels of fishing-induced mortality in marine turtles. Mar Ecol Prog Ser 262:305–309

Plotkin PT (1998) Interaction between behavior of marine organisms and the performance of satellite transmitters: a marine turtle case study. Mar Technol Soc J 32:5–10

Polovina JJ, Kobayashi DR, Parker DM, Seki MP, Balazs GH (2000) Turtles on the edge: movement of loggerhead turtles (*Caretta caretta*) along oceanic fronts, spanning longline fishing grounds in the central North Pacific, 1997–1998. Fish Oceanogr 9:71–82

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