

An aerial view: Insights into the effects of ecotourism on the behavior of whale sharks (*Rhincodon typus*) in Seychelles

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Background: Worldwide, whale shark encounters are a highly sought ecotourism activity. Encounter Codes are implemented to help reduce anthropogenic disturbances. To assess their design and effectiveness, aerial behavioral surveys provide an excellent platform to identify behaviors with little or no observer induced bias.

Methods: Five-minute focal-animal behavioral surveys were conducted during micro-light aerial surveys of whale sharks in Seychelles, both in the absence (n=26) and presence (n=24) of Marine Conservation Society, Seychelles research/ecotourism boats and in-water swimmers (following boat and in-water Encounter Codes). Whale shark behaviors with no anthropogenic influences were identified from encounters without boats and recorded as the percentage of survey time. Ordinal logistic regression (OLR) was used to determine whether the proportion of time sharks spent on the surface was dependent upon environmental, morphometric and/or anthropogenic predictors. Differences between the surface swimming time before and after arrival of a boat were also assessed using a paired t-test.

Results: The altitude of the aircraft was not found to influence whale shark behavior, neither did environmental factors. There was a significant probability of whale sharks spending shorter periods of time swimming on the surface when in the presence of boats and in-water swimmers (OLR p -value<0.001, paired t-test p -value<0.001). Smaller-sized sharks spent considerably longer periods of time on the surface than larger sharks (p -value<0.05), which was more evident in the absence of anthropogenic influences.

Conclusions: Aerial survey methods permit monitoring of behavior without observer induced bias, enabling critical evaluation of encounter management. Boat presence and in-water swimmers did affect the behavior of sharks suggesting that experimental examination of encounter regulations can help determine optimal restrictions to minimize the disturbance to this protected species.

Key words: *Rhincodon typus*, whale shark, ecotourism, animal behavior, aerial survey