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Close-kin mark recapture estimates of whale shark abundance in the Indian Ocean

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Acknowledgement of Country

CSIRO acknowledges the Traditional Owners of the lands, seas and waters, of the area that we live and work on across Australia and pays its respects to Elders past and present. CSIRO recognises that Aboriginal and Torres Strait Islander peoples have made, and will continue to make, extraordinary contributions to Australian life including in cultural, economic, and scientific domains.

Contents

1 Introduction and background

The whale shark (*Rhincodon typus*) is the largest extant species of fish, having a global distribution through tropical and sub-tropical waters. The species is of general conservation concern and is subject to various provisions under IOTC Resolution 25/08 via a retention ban and various restrictions on fishing practices in the vicinity of whale sharks. Despite general concern over their population status, estimating the species abundance is challenging (Rowat et al 2021).

While juveniles and sub-adults occur seasonally at aggregation sites, adult whale sharks are rarely encountered. Therefore, most abundance estimates (e.g. Bradshaw et al., 2008) refer only to these younger age classes and there are no estimates of adult breeding abundance for the species. Additionally, while there have been population genetics studies suggesting widespread geneflow over long time scales, determining whether there is defined generational-scale population structure has been difficult. This information paper is to bring the IOTC SC's attention to a set of new results resulting from a broad-scale CSIRO study of the Ningaloo Reef ecosystem (https://research.csiro.au/ningaloo/wp-content/uploads/sites/59/2025/07/Ningaloo-Outlook-Highlights-Report-2025.pdf). Field sampling as part of this project obtained over 600 tissue samples from juvenile whale sharks aggregating at Ningaloo Reef, Western Australia. Further samples were contributed from collaborators in Madagascar and Tanzania.

Close-kin mark recapture is a technique that uses the prevalence of closely related (parent/offspring, half-sibling) pairs detected among pairwise genetic comparisons, to estimate the adult abundance (Bravington et al 2018). As the offspring carry the genetic material of their parents, their relatedness informs directly on the adults without ever having to sample them (Hillary et al 2018; Patterson et al 2022).

A more detailed overview of this work has been submitted to the Twentieth meeting of the CITES Conference of the Parties (Samarkand (Uzbekistan), 24 November – 5 December 2025) and is available here https://cites.org/sites/default/files/documents/E-CoP20-Inf-021.pdf

2 Results summary

For the information of the SC, the key results are reproduced from the CITES information document as follows.

From the resultant genetic data from 608 samples, 49 half sibling pairs were detected with clear evidence of shared parentage across the Indian Ocean basin. Population modelling estimated that the breeding size in 2000 was N = 3688 (95%CI: 2854–5889) individuals and that this has declined to just under N = 2065 (95% CI:1469–3098) in 2019. The model estimated a declining population trend with a 43.47% decline (95% CI:65%–3% decline) in the 19 years between 2000–2019. While this distribution is wide, there was a 97% probability from our model that there was a population decline and a 73% probability of the decline being greater than 2% per year.

The number of detected kin pairs over a ~20-year period covered by the ages contained in our data set, along with the abundance estimates obtained from these data, provide direct and strong evidence of a low and declining adult population size for whale Sharks in the Indian Ocean. Further

samples are required from other populations worldwide to obtain estimates of breeding population size on a global ocean basin scale, but these data indicate significant cause for concern for the species in the Indian Ocean. However, the results demonstrate that ocean-scale CKMR is a viable technique for monitoring shark species of conservation and management interest and that research efforts for this and other species, should focus on facilitating tissue sampling and aligned data collection.

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