

Investigating Shark And Ray Abundance And Diversity In Mozambique Through Baited Remote Underwater Video Surveys

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Background

Mozambique encompasses part of a global hotspot for shark and batoid (rays, skates, guitarfish and wedgefish) species richness, endemism and evolutionary distinctiveness, with approximately 132 different shark and batoid species documented to date, including two species endemic to Mozambique and a further 23 endemics to the Western Indian Ocean (WIO). There is extensive fishing pressure throughout Mozambique, and sharks and batoids are targeted or incidentally caught in most fisheries, yet most fisheries are poorly regulated and monitored. Slow growth rates, late maturity, and low reproductive capacity make sharks and batoids highly susceptible to overfishing. Consequently, sharks and batoids in Mozambique are heavily overexploited, with 65 species (49%) currently considered threatened with extinction (i.e., Vulnerable, Endangered, or Critically Endangered), while a further 15 species (11%) are classified as Data Deficient, by the IUCN Red List of threatened species.

Due to the paucity of information and increasing threats faced by sharks and batoids from fisheries in Mozambique, an understanding of their distribution, diversity and abundance is essential for informing their effective conservation and management. The Wildlife Conservation Society and Mozambique's Instituto Nacional de Investigação Pesqueira (now Instituto Oceanográfico de Moçambique) have been conducting ecological surveys using baited remote underwater video (BRUV) in Mozambique. The purpose of these BRUV surveys is to provide data on shark and batoid distribution ranges, diversity, relative abundance, size ranges and associated habitat types, to be used for improved management of shark and batoid species in Mozambique.

Method

Since November 2018, stereo-BRUV surveys have been completed at five different locations in Mozambique, including near Pemba (Cabo Delgado Province), Mossuril to Nacala (Nampula Province), Morrungulo and Tofo (Inhambane Province), and the Ponta do Ouro Partial Marine Reserve (POPMPR, Maputo Province). In each location, sampling sites were randomly arranged along the edges of reef habitats, with five stereo-BRUV systems deployed at depths between 5 and 40 m. Within each set of five deployments, each system was deployed a minimum of 350 m from adjacent systems, and each group of five deployments was separated from the next group of deployments by at least 2.5 km. This spacing was to reduce the likelihood of pseudoreplication of having the same shark or batoid filmed by more than one

stereo-BRUV system during deployment. Each BRUV deployment constituted 60 minutes of video footage. A bait canister, holding approximately 1 kg of diced mackerel, was suspended approximately 0.5 m in front of the paired cameras.

Video analyses were conducted by the South African Institute for Aquatic Biodiversity, who identified shark and batoid species present and their relative abundance. Distinguishing among individuals of the same species is challenging, therefore “double counting” was avoided by recording the maximum number of individuals of a single species (MaxN) present in the field of view (i.e., a single frame) at any one time during each 60-minute video. This is used as a measure of relative abundance.

Shark and batoid species richness, a total estimate of abundance (calculated as the sum of all MaxN values, or total MaxN) and the mean number of sharks and batoids recorded per hour (calculated as the mean MaxN per hour) were assessed for each location.

Results

In total, 578 stereo-BRUV deployments were conducted (i.e., 578 hours of footage) across the five locations, including 97 around Pemba, 110 around Nacala, 132 around Morrungulo, 119 around Tofo, and 120 in POPMR. Shark and batoid species richness was highest in Tofo, whereas abundance was highest in POPMR, while abundance and diversity were lowest around Pemba. Overall, at least 24 species (13 batoid and 11 shark species) were recorded across the five locations, including several threatened species.

A key finding from this work is the identification of a probable hotspot in southern Mozambique (particularly the POPMR) for the Critically Endangered whitespotted wedgfish *Rhynchobatus djiddensis*, a species with a poorly known and possibly restricted distribution range. Other noteworthy recordings included two records of the Critically Endangered shorttail nurse shark *Pseudoginglymostoma brevicaudatum* in the Tofo stereo-BRUV samples, despite Mozambique falling outside of the species' known distribution range (at that time), and a single record thought to be the Vulnerable whitetip weasel shark *Paragaleus leucolomatus*, which is known from only a few specimens globally, with very few records in Mozambique.

Conclusion

Despite much research on sharks and batoids in Mozambique in recent years, there remains limited information on their diversity and abundance; however, the results from these stereo-BRUV surveys yield some interesting findings.

The high relative abundance of *R. djiddensis* in Tofo and POPMR demonstrates the importance of southern Mozambique (particularly the POPMR) as a stronghold for this Critically Endangered and CITES-listed species. It is possible that the southern Mozambique population could act as a source population for other areas, such as northern South Africa, where their numbers have drastically decreased over the past few decades.

The recording of *P. brevicaudatum* and *P. leucolomatus* further highlight the shark

diversity in southern Mozambique and, along with the overall BRUV results, support the classification of southern Mozambique as a global hotspot for sharks and batoids, particularly the coastline of Tofo and the POPMR. These results also highlight the effectiveness of stereo-BRUVs for studying wild populations of sharks and batoids, as this methodology is non-invasive and thus suited to research on threatened species and in sensitive habitats, and has the potential to detect the presence of species not recorded in the fisheries. The findings will hopefully contribute to improved management for sharks and batoids in Mozambique.