

Abstract

Spatial Hotspots, Habitat Partitioning and Seasonal Dynamics of Sharks and Batoids in Lhaviyani Atoll, Central Maldives [†]

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Abstract

Introduction: As apex and mesopredators, elasmobranchs help maintain marine ecosystem balance by shaping food-web structure and habitat connectivity, yet more than one-third of species are threatened with extinction. Identifying where and when they aggregate within atoll systems is therefore a prerequisite for spatially explicit conservation planning. Lhaviyani Atoll, in the central Maldives, lies within a recognised Indian Ocean elasmobranch hotspot and hosts two Important Shark and Ray Areas (ISRAs), yet fine-scale information on aggregation sites, habitat partitioning and seasonal use remains limited. **Objective:** To map persistent activity hotspots, characterise habitat partitioning between sharks and batoids, quantify seasonal and inter-annual dynamics, and provide an ecological basis for habitat-focused conservation in Lhaviyani Atoll. **Methodology:** Using a seven-year (2017–2024) opportunistic dive-log dataset of 12,732 SCUBA surveys and 142,994 elasmobranch records across 94 dive sites, spatial kernel-density estimation was applied separately to sharks and batoids to identify activity hotspots and visualise spatial overlap. Habitat associations were examined across substrate types and reef geomorphic zones. Seasonal and inter-annual dynamics in relative abundance and diversity (Shannon, Pielou’s evenness) were quantified across monsoon phases and the 2017–2024 period. **Results:** Twenty-eight species (14 sharks, 14 batoids) were recorded, including 23 listed as threatened on the IUCN Red List (4 Critically Endangered, 12 Endangered, 7 Vulnerable). Four persistent activity hotspots were identified along the northern atoll rim, two overlapping with the Fushifaru Kandu and Kuredhu–Huravalhi–Komandoo ISRAs. Sharks were concentrated along more complex exposed and semi-sheltered slopes and high-flow channels, with significantly higher occurrence on reef and sheltered reef slopes and lower occurrence on rubble and sand substrates; batoids were distributed broadly within lagoonal habitats with no strong substrate or geomorphic preferences. Relative abundance and diversity peaked during the late southwest monsoon (August–September) and declined into the northeast monsoon (December–March); after 2021, diversity and evenness increased while overall abundance declined. **Conclusions:** Persistent hotspots, contrasting habitat



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use by sharks and batoids, and consistent monsoonal seasonality support the ecological relevance of existing ISRAs in Lhaviyani Atoll, while providing finer-scale information on habitat partitioning and additional priority areas for threatened elasmobranchs, including four Critically Endangered species.

Keywords: sharks; batoids; habitat use; hotspots; Maldives

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