LETTER

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Fisher–shark interactions: A loss of support for the Maldives shark sanctuary from reef fishers whose livelihoods are affected by shark depredation

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Abstract

Targets for protecting predatory species often fail to consider the human costs of conservation. Human–wildlife interactions can increase following conservation action and present a major ecological and socioeconomic challenge. Using semistructured interviews ($n = 103$), participatory mapping ($n = 57$) and Baited Remote Underwater Video Stations (50 h) we investigated fisher-shark interactions in one of the world's principal shark sanctuaries. Seventy-three percent of respondents reported an increase in shark depredation postsanctuary implementation. Fisher-reported losses due to shark depredation varied significantly between fisheries and were disproportionately high for reef fishers (>21% of daily vessel earnings). This is attributed to extensive spatial overlap (55%–78%) between reef fishing activity and ecologically validated shark hotspots. We show significant correlations between perceptions of depredation and support for shark sanctuary regulations. Findings demonstrate the need to consider fisher–shark interactions in current and future conservation planning and suggest that management of depredation must be sensitive to diverging perceptions among fisher groups.

KEYWORDS
coral reefs, depredation, fisher livelihood, human–wildlife conflict, perceptions, shark sanctuaries, small-scale fisheries, sustainability

1 | INTRODUCTION

Hunting and habitat modification has depleted predator populations throughout terrestrial and marine ecosystems globally (Estes et al., 2011), placing them at the forefront of conservation efforts. While recovery is the intent of conservation policy, population increase can lead to challenges for natural resource managers, particularly related to human responses (Marshall et al., 2016). Species recovery can increase competition for shared resources—be that food or space—with predator attacks on humans or livestock among the most documented human–predator

interactions (Simpfendorfer et al., 2021). Such interactions result in substantial socioeconomic costs and safety concerns for humans (Nyhus, 2016) and can undermine conservation efforts due to retaliatory killing of threatened predators (Ontiri et al., 2019).

The conservation of sharks (subclass: *Elasmobranchii*; superorder: *Selachii*) has increased in priority as evidence of population decline accumulates and presents an opportunity to diversify the literature on human–predator interactions. Primarily driven by overexploitation, 24% of shark species are at risk of extinction (Dulvy et al., 2021), leading to a shift from target-based conservation measures focusing on sustainable exploitation (i.e., fishing quotas) to limit-based measures (i.e., Marine Protected Areas) that ban exploitation in some areas (Shiffman & Hammerschlag, 2016). Since 2009, 17 countries have declared shark sanctuaries—typically prohibiting all commercial shark fishing, trade, possession, or sale of sharks within their Exclusive Economic Zone (EEZ,(Ward-Paige, 2017). However, sanctuaries still permit fisheries targeting other commercially important species (Vianna et al., 2016) and reports of shark depredation (consumption of fish caught/ damage to fishing gear) are increasing (Ali & Sinan, 2014; Chapman et al., 2021; McKenzie, 2020). This has led to calls for sanctuary regulations to be lifted in the Bahamas and Maldives (Chapman et al., 2021; McKenzie, 2020; UW360, 2021), raising concerns that internal support for sanctuaries may decline as shark populations recover (Chapman et al., 2021).

Shark sanctuaries have typically been declared in small island nations, including the tropical Pacific, Caribbean, and Maldives (Ward-Paige, 2017) where dependence on marine resources is high (Selig et al., 2019a) and capacity for enforcement limited (Vianna et al., 2016). Understanding and resolving depredation impacts is therefore a major socioeconomic challenge (Tixier et al., 2020) and critical for effective predator conservation (Dickman, 2010). Yet, shark depredation remains relatively understudied compared to other fisheries issues (Mitchell et al., 2018). Research around human–shark interactions has primarily focused on perceived threats of shark bites (Carlson et al., 2019; Simpfendorfer et al., 2021), shark bycatch (Molina & Cooke, 2012), attitudes towards shark conservation (Friedrich et al., 2014; Jaiteh et al., 2016) and socioeconomic implications associated with fishery restrictions (Booth et al., 2019). Studies investigating shark depredation are largely restricted to commercial pelagic longline fisheries, with reported depredation rates (% of hooked fish depredated) between 0.9% and 20.7% (Gilman et al., 2007; Gilman et al., 2008; MacNeil et al., 2009; Mitchell et al., 2018). Comparatively little attention has been paid to small-scale (SSFs) or coastal fisheries (Mitchell

et al., 2018). Moreover, despite growing recognition that concerns surrounding human–predator interactions can be manifestations of underlying conservation conflicts (Redpath et al., 2015) most studies simply quantify shark depredation rate, ignoring human dimensions and perceived impacts (Iwane et al., 2021). Inclusive and participatory methods that incorporate stakeholder views and consider both socioeconomic and ecological aspects of depredation are needed to provide a more holistic assessment and aid understanding of fisher–shark interactions (Iwane & Leong, 2020).

In this research, we focus on the Maldives—who declared it's EEZ a shark sanctuary in 2010 following declines in shark catch and in recognition of the economic importance of shark-dive tourism (Ali & Sinan, 2015). Of all the world's shark sanctuaries, the Maldives had the highest shark catch rate per km^2 between 1950 and 2010 (Pauly & Zeller, 2015). While exemptions to a total ban on all shark fishing are in effect in five of the 17 shark sanctuaries, allowing for artisanal catch (Palau, Marshall Islands, British Virgin Islands, Kiribati, Samoa), this does not apply to the Maldives. Moreover, fisheries are integral to Maldivian identity (see Supporting Information for a detailed overview of Maldivian fisheries), employing ~20% of the country's population (~17,589 fishers) and accounting for >80% of Maldivian exports valued at ~US$160 million annually (MEE, 2016). Utilizing semistructured interviews, we aim to increase understanding of fisher concerns and compare the following across reef and pelagic fisheries: (1) perceptions of fisher–shark interaction; (2) fisher-reported catch, gear, and income losses; and (3) how depredation influences support for sanctuary regulations. We also collect spatial data on reef fishing activity (participatory maps) and shark occurrence (participatory maps, Baited Remote Underwater Video Stations) to identify interaction hotspots.

2 | METHODS

2.1 | Interviews

Semistructured interviews were conducted with 103 fishers in North Malé ($n = 66$) and Dhaalu Atoll ($n = 37$) between January and April 2019. North Malé Atoll is home to >30% of the country's population and the capital island Malé, where a substantial quantity of fish is landed daily, while fishing is the main occupation in Dhaalu Atoll (MoFA, 2018). Interviews were conducted at commercial fish landing sites and local islands where vessels were based (Figure 1), with respondents targeted through opportunistic and snowball sampling. Sites were
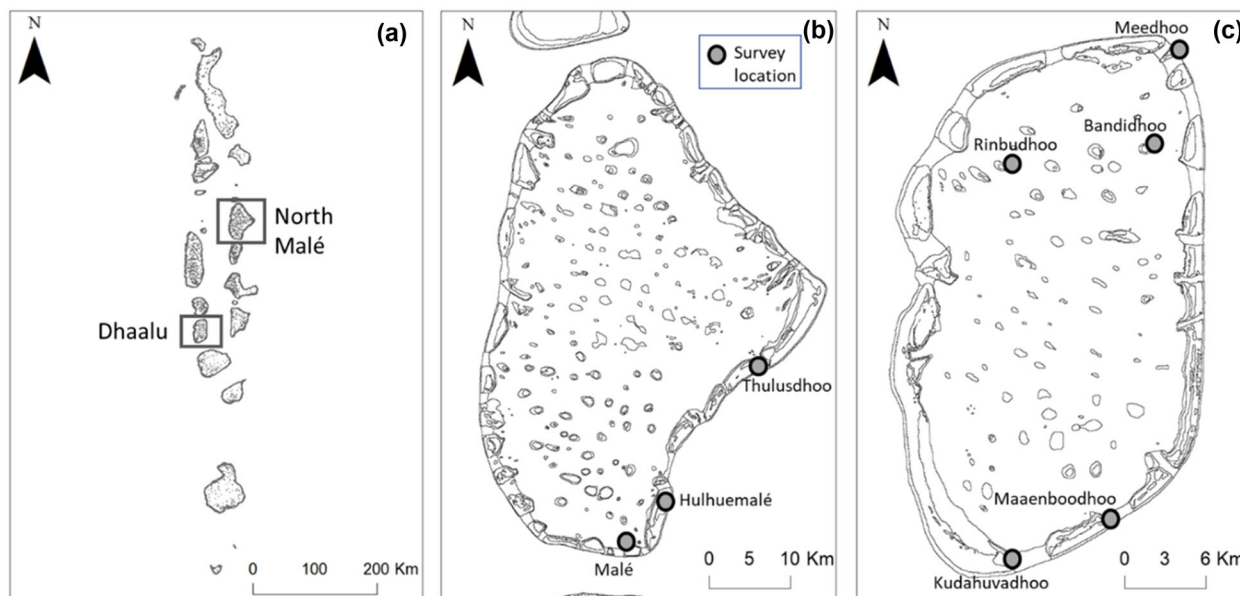
FIGURE 1 Study location. (a) The Maldives is an archipelago of 26 natural atolls, consisting of 1190 coral reef islands in the Indian Ocean and includes North Malé Atoll (4.4167°N, 73.5000°E) and Dhaalu Atoll (2.8469°N, 72.9461°E), (b) interview locations in North Malé Atoll (Hulhuemalé, Malé, Thulusdhoo), and (c) interview locations in Dhaalu Atoll (Bandidhoo, Kudahuvadhoo, Maaenboodhoo, Meedhoo, and Rinbudhoo)

chosen to capture locations with the greatest landings and ensure representation across reef and pelagic fisheries (see Supporting Information).

Interviews were conducted in Dhivehi (Maldivian) and lasted between 20 and 65 min. Interviews assessed fisher perceptions of shark interactions and depredation; perceived impacts on catch, gear, and income; how they perceived interactions to be changing over time; support for the Maldives shark sanctuary; information relating to fishing activities; and sociodemographics (Table S1). In North Malé, 7.9% of registered fishers were interviewed and 5.9% in Dhaalu Atoll.

Participatory mapping was used to elicit spatial knowledge (Turner et al., 2015) and assess overlap between fishing activity and shark occurrence. Reef fishers were prompted to draw polygons to outline their common (frequently visited) fishing grounds and then on separate maps outline areas where they frequently encounter/sight sharks. No restrictions were placed regarding the number, shape, or spatial extent of the polygons. Maps were obtained from 57 reef fishers (North Malé: 31, Dhaalu: 26).

Ethical approval was granted by Newcastle Universities Animal Welfare and Ethical Review Body and research conducted under permits from the Maldives Ministry of Fisheries and Agriculture.

2.2 | Baited Remote Underwater Video Stations (BRUVS)

BRUVS were used to quantify reef shark abundance at 10 sites in Dhaalu Atoll in April 2019 (Figure A1). Sites were selected based on maps generated in interviews and encompassed perceived shark hotspots ($n = 5$), representing areas where ≥50% fishers reported frequent shark encounters, and reef areas not selected by any respondent (control sites, $n = 5$). Five BRUVS replicates were deployed at each site resulting in 50 individual deployments (Figure S1, Table S2).

2.3 | Data analysis

2.3.1 | Interview data

Qualitative data from open-ended responses were explored and coded into themes in QSR NVivo. Catch, gear, and income losses, as a percentage of fisher-reported daily vessel earnings, were compared between fisheries. Ordinal regression models were developed to predict support for the Maldives shark sanctuary with fisher reported loss of catch and damage to fishing gear as predictors. Models accounted for individual socioeconomics and fishing

dependence. Analyses were conducted in R Studio version 3.5.3 (R Core Team, 2019).

Participatory maps were georeferenced, and polygons digitized using ≥3 ground control points (Oniga et al., 2018). Hotspot maps of common fishing grounds and areas of frequent shark encounters were generated by calculating how frequently individual respondents selected the same area. Maps were converted to raster layers (100 × 100 m grid cells) and overlaid to calculate "conflict potential scores" by combining values for overlapping polygons in each map (fishing grounds + shark encounters). These were then visualized with hotspot maps of low/high conflict potential. The area for which the two data sets overlapped was expressed as a percentage. Map processing was completed in ArcMap 10.6.1 (ESRI, 2018).

2.3.2 | Quantifying shark abundance at hotspots and control sites (BRUVS)

For each BRUVS, the maximum number of sharks in a single frame (MaxN/h) was determined for each species, as a metric of relative abundance to avoid double-counting individuals (Cappo et al., 2004). Shark abundance at fisher identified hotspots and control sites was compared using Mann–Whitney U tests.

3 | RESULTS

3.1 | Fisher characteristics

Interviewees were male with an average age of 46.0 ± 10.9 (SD) and 23.6 ± 13.2 (SD) years of fishing experience. Fifty-six percent ($n = 57$) were reef fishers, 26% ($n = 27$) pelagic pole-and-line fishers, and 18% ($n = 19$) pelagic handline fishers (herein pelagic-PL and pelagic-HL respectively). Fishing was the only occupation for 81% of fishers and most (67%) stated that 75%–100% of their household income came from fishing. Thirty-five percent ($n = 36$) of fishers interviewed were former shark fishers, 75% of which moved to the reef fishery following implementation of the shark sanctuary, 16% moved to the pelagic-HL fishery, and 9% moved to the pelagic-PL fishery.

3.2 | Perceptions of fisher–shark interactions

The threat of sharks to fishing practice was perceived as high by 87% of reef and 12% of pelagic-HL fishers; low by 10% and 53% respectively; and no threat by 3% of reef, 35% of pelagic-HL, and 100% of pelagic-PL fishers. Negative shark interactions (catch depredation/ gear damage) were reported by 97% ($n = 55$) of reef fishers and 55% ($n = 10$) of pelagic-HL fishers when fishing for target species. Conversely, 78% ($n = 21$) of pelagic-PL fishers reported positive shark interactions, reporting that sharks maintain tuna (specifically *K. pelamis*) closer to the surface, improving catch success. Pelagic-PL fishers (57%) only reported negative shark interactions during livebait fishing.

Seventy-three percent of fishers with >10 years fishing experience ($n = 84$) reported an increase in shark depredation in the last 5–10 years. This included 93% of reef, 60% of pelagic-HL, and 38% of pelagic-PL fishers. Increases in depredation were attributed to increased shark abundance following shark sanctuary implementation (100% of respondents).

The shark species fishers described interacting with most frequently, significantly correlated with target fishery (Pearson's chi-squared test, $\chi^2 = 25.268$, df = 2, $p \leq 0.001$). Reef fishers reported negative interactions with *Carcharhinus amblyrhynchos, Triaenodon obesus*, and *Carcharhinus melanopterus*; pelagic-HL fishers *Galeocerdo cuvier, Carcharhinus longimanus*, and *Isurus oxyrinchus*. Pelagic-PL fishers reported frequent sightings of *Carcharhinus falciformis*, but this species was not linked to catch or gear depredation. *C. melanopterus* were perceived to be the greatest disturbance for pelagic fishers when livebait fishing.

Seventy-four percent of reef fishers reported changing fishing practice to avoid shark depredation; common measures included changing fishing location (91%), changing bait (17%), killing sharks (12%), or stopping fishing for that day (2%).

3.3 | Shark depredation rate

Perceived loss of catch and gear damage varied significantly between fisheries (Figure 2). For reef fisheries, reported loss of catch (43.1%, 95% CI [37.3, 48.5]) and gear (35.5%, 95% CI [30.2, 40.8])) was substantially higher than pelagic-HL (catch: 6.9%, 95% CI [4.1, 9.7], gear: 9.4%, 95% CI [6.4, 12.3]) and pelagic-PL fisheries (catch: 1.2%, 95% CI [4.1, 9.7], gear: 1.5%, 95% CI [0.66, 2.4]). Regardless of fishery, former shark fishers reported significantly higher catch (Mann–Whitney $U = 1203$, $p \leq 0.029$) and gear (Mann–Whitney $U = 1290$, $p \leq 0.004$) losses than those who did not directly target sharks prior to sanctuary implementation.

Fisher-reported shark driven catch loss equated to an income loss of 21.2% (95% CI [9.3, 33.1]) of daily earnings for reef fishers. This was significantly higher than the relative income loss reported in both pelagic-HL (2.0%, 95% CI [0.2, 3.8]) and pelagic-PL (0.2%, 95% CI [0.01, 0.4]) fisheries (Figure 2c).
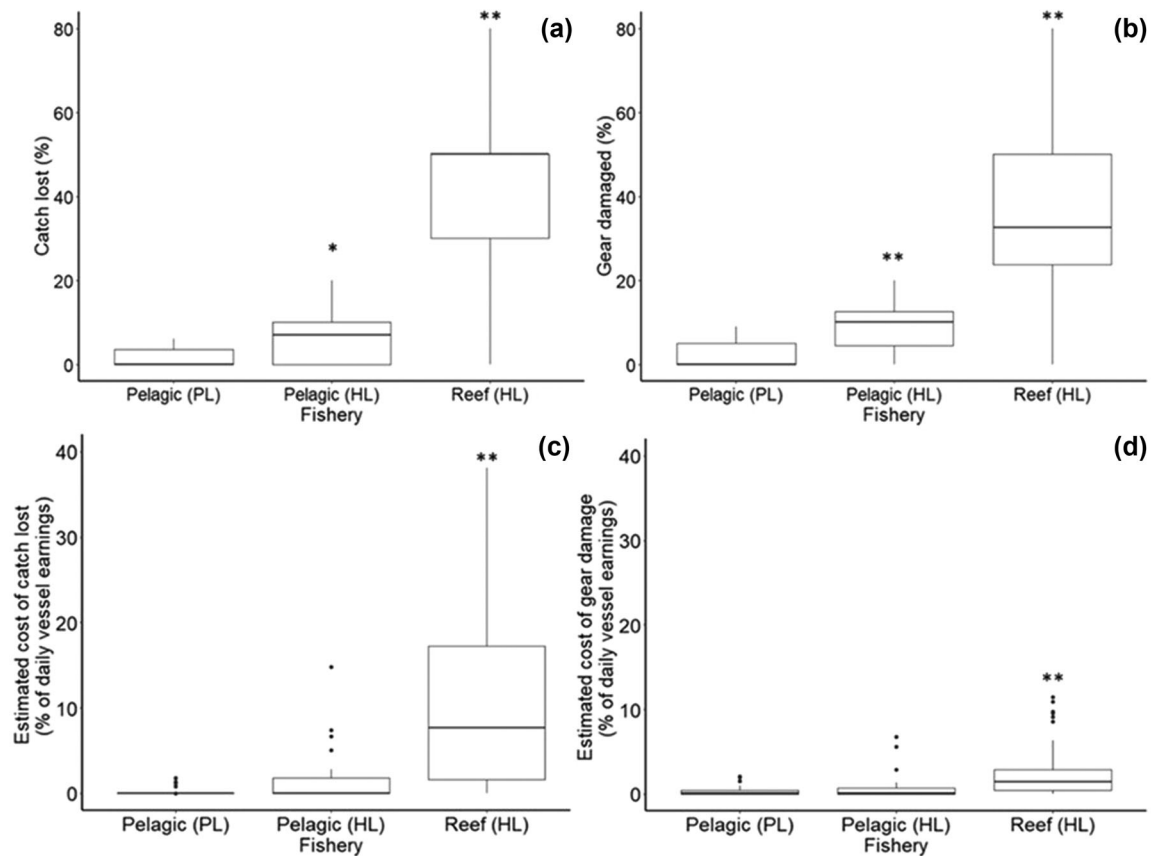
FIGURE 2 Fisher reported shark depredation and income loss. (a) Catch lost and (b) gear damage per vessel per day in pelagic pole-and-line (PL), pelagic handline (HL) and reef handline (HL) fisheries. Estimated economic loss (presented as % daily vessel earnings) associated with catch (c) and gear (d) depredation. Significant differences are marked (Kruskal–Wallis, *$p \leq 0.01$ and **$p \leq 0.001$)

The estimated economic cost of gear losses was significantly higher in reef fisheries (4.1% of daily earnings, 95% CI [1.0, 7.2]), when compared to pelagic-HL (1.0%, 95% CI [0.1, 1.9]) and pelagic-PL fisheries (0.4%, 95% CI [0.1, 0.7]) fisheries (Figure 2d).

3.4 | Does depredation influence support for conservation?

Pelagic-PL fishers were mostly supportive of shark sanctuary regulations, reef fishers expressed opposition, and support varied among pelagic-HL fishers (Figure 3).

All fishers exhibited reduced support as reported gear losses increased (Table 1). Reduced support from reef fishers was also linked to catch losses.

3.5 | Mapping conflict potential in reef fisheries

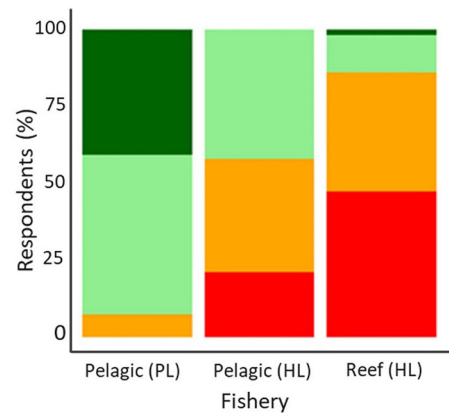Fishing activity was concentrated on outer reef slopes (Figure 4a and d), while shark hotspots were concentrated

FIGURE 3 Fisher support for the Maldives shark sanctuary. Red: Strongly oppose, orange: oppose, light green: support, green: strongly support. Interviews conducted with 103 fishers in 2019

in atoll channels in Dhaalu Atoll (Figure 4b) and outer reefs in North Malé (Figure 4e). Conflict potential between reef fishing activity and areas of frequent shark encounters in Dhaalu Atoll (Figure 4c) and North Malé Atoll (Figure 4f) was high with maps showing a 78% (63 km²) and 55% (128 km²) spatial overlap, respectively (Table S3).

TABLE 1 Ordinal regression models for levels of support for the Maldives shark sanctuary (dependent) as predicted by fisher reported catch depredation and gear damage

Fishery		Odds ratio[1]	95% CI	Std error	t Value	p Value
Pelagic-PL	Catch lost (%)	0.96	0.63, 1.47	0.23	−2.66	0.847
	Gear lost (%)	0.54	0.30, 0.79	0.21	−0.19	0.008
Pelagic-HL	Catch lost (%)	0.85	0.63, 1.04	0.12	−1.36	0.173
	Gear lost (%)	0.76	0.58, 0.92	0.11	−2.39	0.012
Reef-HL	Catch lost (%)	0.92	0.87, 0.96	0.02	−3.44	<0.001
	Gear lost (%)	0.94	0.89, 0.97	0.02	−2.92	0.003

Dependent variable: level of support for the shark sanctuary

[1]All models adjusted for respondents' age (continuous), years fishing (continuous), education (categorical) and dependence on fishing as a source of income (categorical). There was no evidence of lack of model fit (See Table S2) using Hosmer–Lemeshow tests. Pseudo-R^2 (McFadden's) were 0.20 (pelagic-PL), 0.32 (pelagic-HL), and 0.34 (Reef).
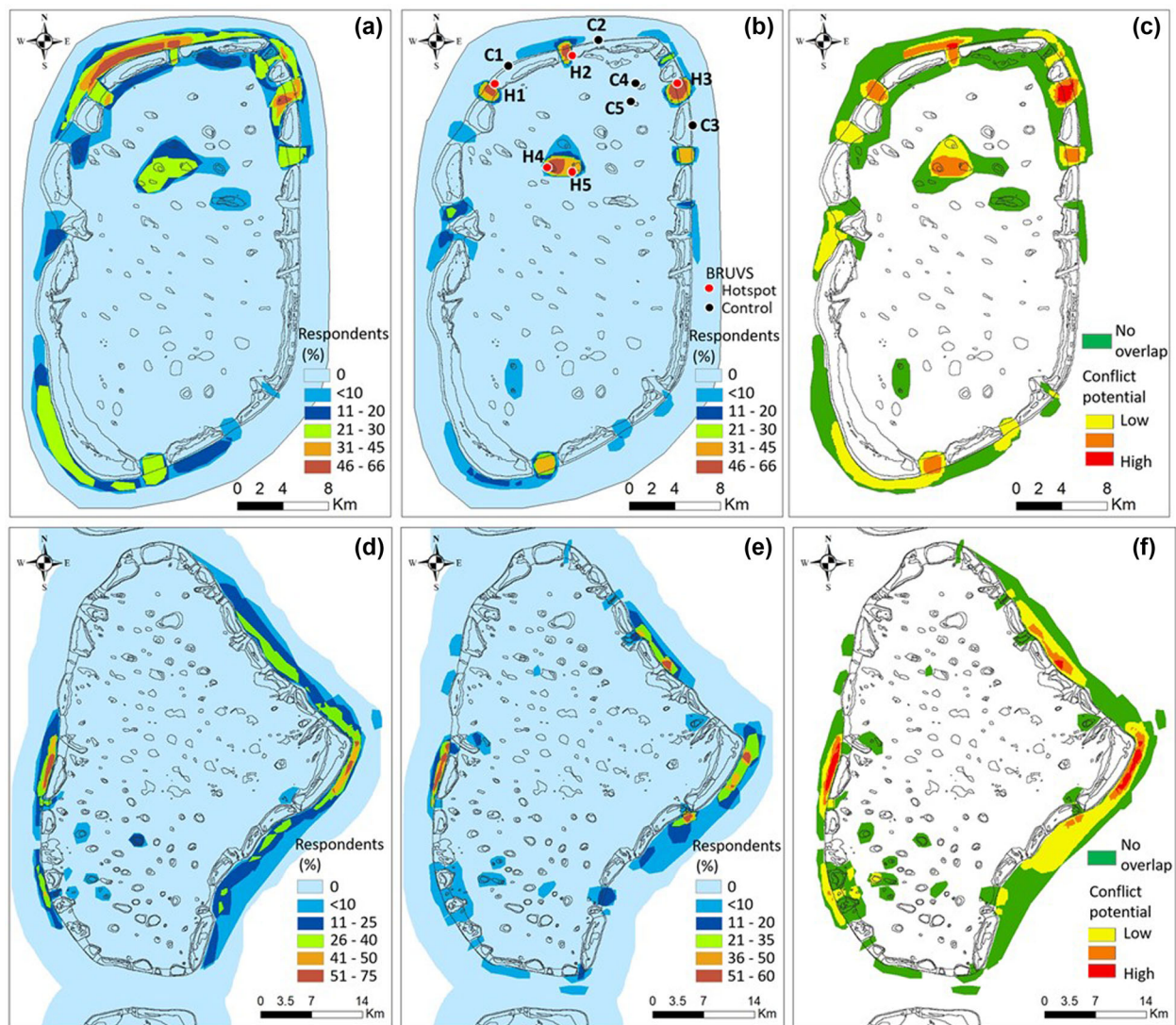

FIGURE 4 Hotspot maps of fishing activity, areas of frequent shark encounters and areas of potential conflict in Dhaalu (a–c) and North Malé Atoll (d–f). Reef fishers were asked to mark their common fishing grounds (a, d) and areas of frequent shark encounters (b, e) during interviews. Points and labels represent perceived hotspots and control sites where BRUVS were deployed. (c, f) The overlap between reef fishing grounds and shark distribution

TABLE 2 Summary of shark occurrence and relative abundance on BRUVS deployed at perceived hotspots and control sites in Dhaalu Atoll (sites shown in Figure 4b)

Site	Total (*N*)	Occurrence (% BRUVS)	MaxN/hour (mean ± SD)
Hotspot (H1)	8	60	1.60 ± 1.95
Hotspot (H2)	12	100	2.40 ± 0.89
Hotspot (H3)	14	100	2.80 ± 1.30
Hotspot (H4)	10	100	2.00 ± 0.71
Hotspot (H5)	5	60	1.00 ± 1.22
Control (C1)	5	60	1.00 ± 1.00
Control (C2)	6	80	1.20 ± 0.83
Control (C3)	4	40	0.80 ± 1.09
Control (C4)	0	0	0.00
Control (C5)	2	40	0.40 ± 0.55

3.6 | Quantification of reef shark abundance

In total 49 sharks were recorded on BRUVS at perceived hotspots (*n* = 25) with at least one shark recorded on 84% of deployments (Table 2). Comparatively, 17 sharks were recorded on BRUVS at control sites (*n* = 25) with sharks recorded on 44% of deployments. Shark abundance (1.96 ± 1.36 h^{-1} vs. 0.68 ± 0.90 h^{-1}) was significantly higher (∼2.5 times) at perceived hotspots versus control sites (Mann–Whitney = 389.5, *p* < 0.01). *C. amblyrhynchos*, *T. obesus*, and *C. melanopterus* were the most common species recorded (Table S5).

4 | DISCUSSION

This study provides valuable insight into fisher perceptions of shark depredation within one of the world's principal shark sanctuaries. Prior to this study, limited information was available regarding fisher–shark interactions in Maldivian fisheries, despite high shark diversity (Sinan et al., 2011), local dependence on fishing (Yadav et al., 2019), and anecdotal reports of increasing shark depredation (Ali & Sinan, 2014). Most fishers perceived depredation increased postsanctuary implementation due to increasing shark abundance. However, reported catch and gear losses were disproportionately high among reef (vs. pelagic) fishers, equating to estimated income losses of >21%. Findings highlight the socioeconomic complexities of shark conservation and the need to sensitively address depredation concerns to avoid negative implications for fisher welfare and shark population recovery.

Despite the perception that shark populations have substantially increased, ecological studies in the region suggest that reef shark populations remained stable between 2016 and 2020 (Robinson & Newman, 2021, unpublished data), while global analyses show continued declines in pelagic species across the Indian Ocean (Pacoureau et al., 2021). Further, given the *k*-selected life history traits of some sharks including slow growth, late sexual maturity, and small brood sizes, population recovery is inherently slow (Smith et al., 1999). Reports of increasing depredation are likely marked by a shift in how fishers view sharks from a valuable resource to exploit to competitors for resources. Shaped by sociocultural beliefs, economic pressures, and past interactions (Dickman, 2010), perceptions of depredation are widely considered to overestimate reality and can require more mitigation than actual costs incurred (Guerra, 2019). In the Maldives, shark fisheries were driven by economic gain rather than cultural value (Techera, 2019), thus fisher-reported estimates of catch and income losses are likely subject to strategic bias—where fishers have strong incentive to overrepresent damages (Davis et al., 2021). This may be exemplified in SSFs as the economic cost of depredation has direct impacts for individuals rather than operations (Smith et al., 2021), with even relatively small losses perceived to have a proportionally large impact on livelihood, leading to economic distress and prompting fishers to complain more about depredation (Gonzalvo et al., 2015). Moreover, 63% of the reef fishers in this study were former shark fishers, thus sanctuary regulations themselves could shape perceptions or be a proxy for human–human conflict (Iwane et al., 2021; Simpfendorfer et al., 2021), with reef fishing generating lower economic returns than shark fishing (Ali & Sinan, 2015).

Negligible losses reported by pelagic-PL fishers, align with data collected in Maldives by fishery observers (Miller et al., 2017), and can be attributed to the highly selective nature of this fishery. Comparatively, reported losses were significantly greater for pelagic-HL and reef fishers, highlighting the need to differentiate between fishery and gear types in mitigation strategies (Baynham-Herd et al., 2020). Acknowledging diverging perceptions and inequitable impacts across groups is important as most studies consider fishing communities as one homogenous entity, with management effort and political interest focused on high value pelagic fisheries (Selig et al., 2019b), leading to marginalization of SSFs in conservation frameworks (Cohen et al., 2019). Historically this has been the case in Maldives, with a ban on reef shark fishing implemented without fisher consultation in 2009 (Sinan et al., 2011), while concerns raised by pelagic-PL fishers have influenced shark management since 1981 (Ali & Sinan, 2015). Pelagic-PL believe sharks can improve catch success, while most reef and pelagic-HL fishers view sharks as a threat to fishing practice—such perceptions, alongside

historical conflicts related to the management of sharks may also underpin depredation concerns and explain the variance in perceptions between fisher groups.

Reports of substantial catch and income losses in reef fisheries may also be due to high spatial overlap between shark hotspots and reef fishing activity (see participatory maps) with both favoring outer reef habitats that sustain high densities of teleost fish (Tickler et al., 2017). While we recognise that spatial data will be constrained by fishing effort and sample coverage, BRUVS confirmed that fisher-identified shark hotspots had higher shark occurrence rates and significantly greater abundance relative to control sites within the atoll. Moreover, abundance was substantially greater (>8×) than regional averages (MacNeil et al., 2020). Historically a subsistence fishery, extraction of Maldivian reef resources has increased in the last few decades (Sattar et al., 2014), driven by domestic markets and growing demand for reef fish from tourists (MoT, 2018) and evidence suggests the fishery is approaching maximum sustainable yield (Sattar et al., 2014). We suggest that increased reef fisheries exploitation coupled with localized fishing activity in areas of high shark abundance may be intensifying competition and/or associative foraging behaviors (e.g.,(Newman et al., 2010) leading to increased fisher–shark interaction (Schifiliti et al., 2014).

Shark habituation, where sharks associate vessels with accessible food, may therefore account for differences in fisher perceptions of shark abundance and ecological evidence. Field studies have documented faster shark arrival times, changes in habitat-use and increased depredation rates in areas subject to greater fishing pressure (Carmody et al., 2021; Mitchell et al., 2020). Thus, interactions between fishers and sharks could be increasing despite populations remaining stable. The chance of behavioral associations forming is likely to be increased if fishing activity overlaps with the small home ranges and high site fidelity of certain shark species (Mitchell et al., 2020), such as *C. amblyrhynchos, T. obesus*, and *C. melanopterus*, which were identified in this study as the main species depredating on reef fishers catch and the most common species recorded on BRUVS. Our maps provide an initial underpinning for the identification of areas with high interaction/conflict potential and outline rapid, low-cost methods, which can be readily utilized in data poor regions to overcome financial and logistical constraints to spatial data acquisition (McQuatters-Gollop et al., 2019).

While we acknowledge that the implications of increasing fisher–shark interactions (real or perceived) will be context specific, our findings raise important issues relating to trade-offs between policies to protect biodiversity and those related to human welfare (Booth et al., 2020). The perceived severity and inequity in fisher-reported depredation costs suggest that shark depredation could

exemplify economic difficulties experienced by income-insecure SSFs. This could lead to negative implications for the achievement of sustainable development goals (SDGs), including SDG 1 (no poverty), SDG 2 (zero hunger), and SDG 14 (sustainable marine resource-use) particularly within sanctuaries that ban artisanal shark catch and where SSFs are critical sources of livelihood and food security (e.g., New Caledonia, Cook Islands, Honduras) (Bell et al., 2018; Canty et al., 2019). Further, correlations between fisher-reported depredation losses and sanctuary support suggest that unless concerns are addressed shark conservation policies could lose legitimacy—here 12% of fishers reporting retaliatory killing to reduce interactions.

The integration of knowledge and fisher perceptions through participatory research efforts in this study is an important first step in understanding shark depredation in Maldivian fisheries; however, future research is needed to distinguish underlying values and the ecological, socioeconomic, cultural and political factors that contextualize depredation concerns (Iwane & Leong, 2020; Simpfendorfer et al., 2021). Open dialogue to monitor fisher perceptions and incorporate different opinions in fisheries management and conservation is recommended to help identify solutions that protect the welfare of all fisher groups while promoting sustainable shark conservation. Findings also suggest that altering spatial fishing patterns or regularly changing sites could reduce depredation in reef fisheries as shark hotspots were localized relative to the larger reef system.

AUTHOR CONTRIBUTIONS
DR, SPN, and SMS designed research. DR performed research and analyzed data. DR, SPN, MJW, RMF, MSA, and SMS wrote the paper.

COMPETING INTEREST STATEMENT

The authors declare no competing interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.