
SHARK FISHING IN THE UNITED ARAB EMIRATES: A CONSERVATIONIST'S PLEA FOR ENHANCED PROTECTION AND SUSTAINABLE SPECIES MANAGEMENT

Riaan VAN DER MERWE^{1,*}

¹ Department of Civil Infrastructure and Environmental Engineering,
Khalifa University of Science and Technology, Abu Dhabi, United Arab Emirates

Abstract

Challenges that relate to shark conservation may well be a combination of the intersection of people's livelihoods and the ineffectiveness of management strategies. Given the current protection initiatives as well as the implementation of tighter laws restricting hunting and trade, shark conservation is still recognized as a major environmental challenge. The United Arab Emirates (U.A.E.) is used as an export hub and is one of the primary exporters of shark fins to Hong Kong, with a large proportion of fins traded to be from species at high risk of global extinction. The present-day management of shark fisheries also shows shortcomings concerning lawfulness, specifically those relating to regulatory compliance, fishing techniques, and control of finning occurrences. These concerns are not unique to the U.A.E. but emphasize the fact that there are far-reaching problems related to shark conservation. Even in a milieu of strengthened conservation measures and revised legislature, existing information on the effectiveness of a shark finning ban may still be misleading when viewed in the light of over-exploitation and global species abundance. It is therefore important that proper management must be implemented at the inception of shark fisheries. For the U.A.E., this has not always been the case. Instead, the trend was one of limited control and lack of compliance, unfortunately, resulting in a rapid decline in shark abundance, to the point where sharks struggle to recover. This paper focuses on the importance of the species, reviews the current monitoring framework, and seeks to enhance shark protection.

Keywords: Shark fisheries; Arabian/Persian Gulf; Fisheries management; Conservation; Save our Sharks; Environmental regulations

Introduction

Worldwide, shark stocks are severely under pressure due to overexploited and unregulated fisheries [1, 2]. Although sharks are targeted in fisheries operating in the Arabian/Persian Gulf (hereafter the Gulf), information on regulatory and law enactment remains deficient [3–5]. It appears that the limited capacity of regulatory officers and the fact that action-plans are implemented voluntarily without the legal basis of continued enforcement. Besides the obvious concern over the potential extinction of certain shark species, the likely economic repercussions of the fisheries collapse, and the negative effects of the decline in specifically reef predators would be devastating as well. Impacts of chronic overfishing are evident in population depletions, yet indirect ecosystem effects induced by predator removal from oceanic food webs remain unpredictable. Earlier studies suggested that the removal of sharks (from their ecosystem) will not only have the projected effect of releasing control over

* Corresponding author: riaan.vandermerwe@ku.ac.ae

their main prey but can also lead to unexpected second and third-degree effects on non-prey species through trophic linkages [6]. It does however appear that analogous top-down effects may be a predictable consequence of eliminating entire functional groups of predators [7, 8]. Total annual mortality rates for sharks are extremely high as evidence suggests that about 100 million sharks are caught every year, the bulk of which are unreported and ill-regulated catches [9–11]. Currently observed declines precede previous reported collapses of coastal- and pelagic sharks by several decades, and the magnitude of species decline is increasing globally [12]. Similarly, shark populations in the Gulf are severely threatened due to unregulated fisheries and international trade in shark products [13, 14].

Shark fishing is a dynamic social-ecological system, where regulators seek to balance socio-economic interests and conservation. It remains an ongoing battle between "sharks-as-a resource" to provide a source of income versus species protection policies [15, 16]. Declines have led to concern about the future of regional shark stocks. Regional studies provide evidence that U.A.E. fisheries are largely driven by shark fin export markets and that the U.A.E. act as a global export center for the international shark fin trade with reports of exports up to 500 metric ton annually to Hong Kong [13]. Nonetheless, much of the shark trade remains unregulated, and because different species have various natural capacities to adapt to anthropogenic pressures, management and conservation efforts will necessitate accurate species-specific capture and trade data. It is well accepted that overexploitation of sharks affects the stability and health of the entire marine system, and as they play a very particular role in sensitive ecosystems such as coral reefs [11]. Specific to the U.A.E., a dedicated research program on elasmobranchs did not exist until 2010, consequently resulting in a lack of information on species diversity, distribution, biological data, species composition, and amount of fishing effort directed specifically towards the shark fishery. This lack of information may have been a hindrance to the creation of protection efforts and conservation of the species. U.A.E. fishermen have also reported a general decline in shark catches, abundance, and species size [13]. This strongly suggests that the shark fishery is currently been overexploited. Since then (in 2017) the Environmental Agency – Abu Dhabi (EAD) in cooperation with International Union for Conservation of Nature (IUCN) Species Survival Commission Shark Specialist Group had published a report which provided an overview of the conservation status of chondrichthyan (sharks, rays, and chimaeras) in the Arabian Seas Region (ASR). It identified those species that are threatened with extinction at the regional level, so that appropriate conservation action can be taken to improve their status.

Policy development cannot be formulated within a vacuum, and it is therefore important to note that public perceptions can underwrite the policy and decision-making processes [17]. Debatably, the main concern relating to human-shark interaction is unfortunately that it still emphasizes the risk posed to humans as opposed to the risks that humans pose to sharks [18, 19].

Why is the conservation of sharks important?

Due to their size and predatory behavioral traits, reef sharks play a very important ecological function. Additionally, a recent study revealed that most reef-associated shark species do not act as apex predators, but instead function as mesopredators (a species that occupy a high trophic position but are below apex predators and are themselves vulnerable to predation) along with various reef fishes [1]. Another study also supports this stance with evidence and data collected from stomach contents and stable isotopes analysis to assess diet

and trophic position for three common species of reef sharks. Via qualitative and quantitative comparisons with other sharks and large predatory fish, the authors confirmed that their functional position was not as the presumed apex predator, but rather occupying functions close to those of large reef fishes usually considered to be high-level mesopredators [20]. This finding necessitates a better understanding of how reef ecosystems work and how shark removal can affect reefs, thus also the importance of a more holistic environmental management approach.

Most fishery scientists believe that sharks have the potential to modify the community structure of marine food webs, either through direct or indirect interactions resulting from the consumption of prey and/or the alteration of species' behavior as a result of their presence [21]. Hypothesized shark-driven trophic cascades that benefit corals however remain weak, equivocal, and in many cases unsupported [1]. Even so, restoring shark populations remain critical as part of the ecosystem processes as reef-associated mesopredatory sharks:

- i) provide nutrient cycling between adjacent pelagic- and reef habitats [22, 23];
- ii) play an important role as facultative scavengers (consuming carcasses); and
- iii) they have the potential to exert top-down control of invasive species [24].

Whilst these processes remain critical to population structure and function, they are often poorly quantified in coral reef ecosystems [1, 20]. Commercially, shark fisheries provide jobs and income for communities, not only regionally, but across the world. The rise in ecotourism is also placing a financial value on the presence of sharks. Only by managing fisheries sustainably can we ensure people's livelihoods in the future. The main concern, however, must be to continue advocating for improved shark conservation and fishery management given the rapid decline in global shark populations.

Overview of regional shark fisheries

Economics of shark fishing in the Arabian Seas Region

Although sharks receive new priority in marine conservation, the fin trade has also grown substantially. Many problems associated with shark exploitation are related to the economics of these particular fisheries, primarily as a result of two contradictory factors. First of all, research and management of sharks and rays were (for many years) hampered by the disillusioned view that the species offer very little economic value. As a result, research funds were usually granted to resources seen economically more important than elasmobranchs. The insight that sharks may be more valuable alive than on a "menu" lately also create economic incentives for protecting and sustainably managing marine ecosystems and species, including sharks [25, 26]. On the other hand, the high monetary value of fins in the international market has stimulated the fishery industry to target sharks. The ongoing changing aspects of these two processes cause ongoing difficulties for those with conservation interests. Studies revealed that the Arabian Seas Region plays an important role in the global landings of sharks and rays [27, 28]. The authors state that observed landings varied among regions and across seasons, results clearly showed that shark landings were dominated by small-sized specimens, which is indicative of overexploitation. As a marine resource, sharks contribute at least \$1 billion to national economies annually through fisheries, trade, and tourism [29]. Yet, despite their ecological and economic importance, their value is not reflected in their management. We may require the establishment of systems for optimally and equitably economic-benefit distribution, to provide compensation and/or incentives for fishers and to reduce their impact on shark populations. This can be an effective and economically viable approach to promoting

sustainable fisheries management, provided they are established and managed appropriately [25]. Saying this, scientists agree that catches of elasmobranchs are still substantially higher than indicated by different official statistics [30], and paired with the unlikely odds that sharks will be sustainably exploited in the future, yet again emphasize that a precautionary approach will be necessary to mitigate anthropogenic pressures, regardless of possible economic gains.

Legislation

There have been progressive revisions on regulating the fishing and trading of sharks in the U.A.E. over the last decade, i.e. Ministerial Decree No. 500 for the year 2014 (Article 1-8), and most recently, Ministerial Decree No. 43 for the year 2019 on Regulating the Fishing and Trading of Sharks. This Decree was published in the official gazette and entered into effect on March 1st, 2019. The Emirates made noteworthy progress with regards to regulating shark trade and fishing and also implemented its obligations under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Also, the Ministry of Climate Change and Environment recently published a shark assessment report (https://www.moccae.gov.ae/assets/download/99c10e62/shark_assessment_report_6-6-2018_eng.pdf.aspx) which is the first national assessment of shark research and protective measures in the U.A.E. and highlights that there is insufficient knowledge on the biology, ecology, and fishing of sharks. The National Plan of Action For the Conservation and Management of Sharks (https://www.moccae.gov.ae/assets/download/cf59d1f/National_Plan_of_Sharks_Brochure_Online_ENG.PDF.aspx) is the first step towards effectively protect and manage shark populations in the U.A.E. Also, several multi-lateral environmental agreements (incl. CITES, regional fisheries management organizations, environmental protection agencies, and ministries) have created action-plans and legislation to regulate shark fishing and trade. Although established, in order to deliver successful protection outcomes, these efforts must translate to implementing legislation and management actions at local, regional, and international levels—which can be adopted at scale. Despite the evidence of increasing concern for the conservation of sharks among scientists and environmental conservation advocates in the Arabian Seas Region, it appears that the lack of adequate law enforcement impedes fisheries management and current conservation efforts [4, 5, 31]. While the focal point of the fin trade is still considered to be Asia, the U.A.E.'s ports of entry are central to the global shark trade, making the latest Decree an important milestone in regional shark conservation. Table 1 (provided as supplemental material as Appendix 1) shows a summary of Ministerial Decree No. 43 for the year 2019 (with an emphasis on Articles 1–4, as the others point out non-relevant general provisions, veterinary quarantine, cancellations, and the Decree effective date only (full version available: <https://www.moccae.gov.ae/assets/download/144a428e/3a4c74dd.pdf.aspx?view=true>)).

Looking at the Decree in detail, it appears that there may still be loopholes under the re-exportation of shark-products. Article 3 states that sharks (even the species set out in the appendices under CITES) may be imported in any form into the U.A.E. The problem remains, that in reality, regulators and enforcers have very limited control and management procedures in place to record and monitor trans-boundary trade. Previously (under Ministerial Decree No. 500 for the year 2014), sharks caught in U.A.E. waters were prohibited for export (applicable throughout the year), but now, Article 4 creates an ill-fated opportunity for locally caught

sharks (and products) to be “re-exported”. Like many researchers, even the enforcers may not be sufficiently familiar with the technical aspects of environmental policymaking to perform governance relevant implementation to avert illegalities [32]. Such a situation can lead to futile opportunities and may affect shark conservation policymaking. There remains an urgent need to scrutinize trade regulations as an additional measure for shark conservation and appropriate regulatory efforts can assist in making a significant contribution. This, however, can only be effective if the regulatory frameworks are vigorously policed and offenders prosecuted. Unfortunately, the large spatial scales and often remoteness of illegal fishing activities present a challenge for surveillance and enforcement. This will require a level of infrastructure (adequate vessels and aerial/remote sensing surveillance tools) often beyond the capacity of many enforcers. Furthermore, uncertainties about enforcement capacity have generated substantial debate regarding the effectiveness of sanctuaries as a shark protection haven [3]. A study reported that neither zone size, water depth, nor reef rugosity explains details for major differences in shark abundance [16]. This strongly indicates that governance and policy enforcement may be a main driver of productive shark conservation in these areas. The problem with the “no-take” approach however is, whilst protecting sharks in these zones can be effective, it may inadvertently result in displacing unregulated fishing, or even (as a worst-case scenario) provide devious and opportunistic prospects for poachers to capitalize on areas of high species abundance. It again lay emphasis on the urgent need for improved fisheries management to stem species exploitation, also in the Gulf.

Conservation and sustainable management priorities

Although solutions for many shark-associated conservation issues currently exist, part of the management adeptness certainly lies in propagating feasible and science/knowledge-based solutions to the broad public and participating fishers. Conservationists agree that a better understanding/knowledge about sharks may well increase public awareness about the species’ protection [19]. It is therefore important that information is not be restricted to the scientific community only, as support from the general public would increase pressure on regional regulators to police and implement conservation measures [33]. Another major struggle in gaining support for shark conservation could be the negative preconceived notions of fishermen and those held by the general public toward sharks. Many still see them as mindless predators or vicious man-eaters, which has been one of the main difficulties relating to protection efforts [34]. Additionally, the role of media reporting (past and present) has also shaped and contributed to the public’s view of sharks and human-shark interaction [35]. Yet, there still appears to be a misapprehension regarding the media’s influence on policy development within the context of anthropogenic impacts [18, 36, 37].

Trade in shark products (meat and/or fins) remains a complex and often misconstrued industry, with key terms (fishing vs. finning) often misused. This adds to the confusion and has driven the focus for reform on less effective policy- and management solutions [38]. The question remains: “Could a regional embargo on trade in shark products really be an effective measure, or will it just undermine current sustainability efforts?” It is key to gain a better understanding of the social framing of human-shark interaction to develop the crucial protection

policies, and to correct the misunderstanding of shark conservation threats [39]. Previously proposed solutions have mostly been categorized into: i) those aiming for sustainable exploitation; and ii) those that wish for a total ban on exploitation and sale of shark products. There is also an opinion within the research community that these fishing bans may be appropriate only when sustainable fishing and trade are impossible, such in regions with inadequate fisheries management and regulatory enforcement resources [38]. There are numerous conservation policies that are applied to the conservation and management efforts of sharks, many of which are mutually exclusive. Shiffman, *et al.* [39] states that a country cannot have a well-managed sustainable fishery while all fishing in that country is banned. Similarly, a country cannot be a source of sustainably exploited shark fins if the sale of shark fins is completely banned in that particular country. Conversely, it is worth mentioning that a country with deficient enforcement of fishery regulations/decrees likely would also be unable to impose a proposed ban on trade. This leaves the U.A.E. in a challenging position, as even though decrees set the stage for improved protection of the species, enforcement and monitoring may still be lacking (especially at landing sites and fish markets). Because the country plays such an important role in the global fin trade, continual studies would be needed to characterize sharks at landing sites as well as products traded from this location. The fact that trade also pertains to transboundary issues further adds to the complexity of fisheries management in the Gulf.

A sustainable shark fisheries industry in the U.A.E. may still be preferred as a policy, for a total ban is likely to have a negligible direct effect on global shark mortality, even though sharks remain of the most threatened vertebrates in the region and their population declines have been almost entirely driven by overfishing [5, 40]. Furthermore, problems remain related to species identification with untrained personnel (if any) at landing sites. The implementation of accurately reporting species would aid quantifying shark distribution patterns and traceability of shark products. Assessing trends of shark distribution and species-specific habitat interactions in response to geographical and environmental factors are crucial to weighing the risks of overfishing and habitat loss [41–43]. It will be necessary to strengthen the national program on fisheries statistics with wide and spatial-temporal coverage, with extensive species-catch monitoring (as a minimum requirement) at the primary markets and landing ports. The pertinent Ministries, in combination with the local authorities (e.g. Environment Agency – Abu Dhabi) need to invest in educational awareness programs and research efforts to enhance management strategies that include recommendations on catch quotas (based on scientific estimates of elasmobranch population statuses), monitoring of existing, and feasibly expanding of marine protected areas (no-take zones (and closed seasons)) and stringent protection for threatened species. The success of such measures (incl. those of protected areas) is currently under scrutiny as studies reported a significant shortfall in effectiveness with only 20-50% of protected areas were found to be properly policed and managed [44]. There are numerous, even globally renowned protected areas, that are currently experiencing serious ecological degradation [45], partly due to unsatisfactory management processes and illegal species exploitation. There remains a need to ensure that regional (and international) targets for increased protected area coverage translate into tangible benefits for biodiversity conservation and the recovery of threatened species.

Conclusions

It is recognized that a change of community-based behaviors alone will not solve the issues pertaining to shark fishing and the trade in fins. The issues are much more complex than simply educating people in an attempt to alter their attitudes toward these predators. Additional regional issues that need addressing must include:

- i) science/research-based knowledge;
- ii) apt attitude towards conservation and protection efforts of sharks;
- iii) cultural view concerning the species;
- iv) regulatory framework, monitoring and enforcement (with consequences); and
- v) alternative/improved livelihoods for fin fishers.

These issues accentuate that successful conservation of sharks only occurs when no-fishing areas are coupled with feasible attempts to include local communities and fishermen in conservation- and management activities through offering lasting alternatives to sustain their livelihoods. It is very clear that although the designation of no-take zones may result in the protection of marine life, it will only be successful if it is embedded within broader conservation management strategies, which include providing fishers (and their wider communities) with feasible money-making options [16]. For future spatial planning and shark management, a recent study suggests that strong fisheries management in addition to marine protected areas will be necessary for effective shark protection [43]. Despite recent advances made in management regimes and advocacy, and the fact that numerous regional decrees and regulations for the conservation of the species do exist, the regulatory framework remains fragmented across most of the seven Emirates (Abu Dhabi, Ajman, Fujairah, Sharjah, Dubai, Ras Al Khaimah, and Umm Al Qaiwain) of the U.A.E. Trade routes remain difficult to define and span across legal jurisdictions of several countries, further highlighting the need for conservation actions not only locally, but also at trans-boundary levels (incl. the State of Kuwait, Kingdom of Saudi Arabia, Kingdom of Bahrain, State of Qatar, Sultanate of Oman, Republic of Yemen). The wide range and highly migratory behavior of many shark species suggest that regionalized management strategies may have adverse implications.

An inclusive, well-managed, and sustainable shark fishery in the U.A.E. remains a challenge. This is not only a regional problem but also a commonly stated dilemma in shark fisheries management across the world. Besides the political will and lack of regulatory enforcement, the deficiency of robust scientific data is impeding progress towards well-managed shark fisheries. Some developed countries have carried out wide-ranging research, but fewer studies have been performed in developing nations, often with higher shark biodiversity, highlighted by non-effective fisheries management and a lack in policy enforcement means [27, 32, 46, 47].

It is apparent, that to ensure a sustainable shark fishery it will require substantial enforcement resources, which can undertake vessel patrols at sea, inspections in landing ports, and most likely a variety of electronic vessel monitor systems (transponders (even for artisanal fishing vessels)). It is already a requirement, presented in Article 1 of Ministerial Decree no. 43/2019, on the regulation of fishing and marketing of sharks so that vessels targeting sharks are registered and marked visibly. This should allow regulatory authorities easy access to

monitor their activities at sea and to record species-specific data at landing sites. Instituting and enforcing such management systems requires the appropriate infrastructure, unfortunately lacking at present. At the same time, some regulatory guidelines may not be politically possible, especially in areas with fisheries of greater monetary value (e.g. Musandam Governorate, Oman). Sharks are not the only threatened elasmobranchs, and other species (e.g. rays) are even more understudied in the region. It is imperative to be conscientious of these fisheries, and more studies on other elasmobranchs are desperately needed.

It would, therefore, be important to put into action strategies that will enhance existing conservation and management policies, combined with stringent trans-boundary law enforcement. Regional fisheries remain an integral part of the local society. On the other hand, it remains true that fisheries management has in fact very little to do with managing “fish”—but all to do with managing people.

References

- [1] G. Roff, C. Doropoulos, A. Rogers, Y.M. Bozec, N.C. Krueck, E. Aurellado, M. Priest, C. Birrell, P.J. Mumby, *The Ecological Role of Sharks on Coral Reefs, Trends in Ecology and Evolution*, **31**, 2016, pp. 395–407.
- [2] M.A. MacNeil, D.D. Chapman, M. Heupel, C.A. Simpfendorfer, M. Heithaus, M. Meekan, E. Harvey, J. Goetze, J. Kiszka, M.E. Bond, L.M. Currey-Randall, C.W. Speed, C.S. Sherman, M.J. Rees, V. Udyawer, K.I. Flowers, G. Clementi, J. Valentin-Albanese, T. Gorham, M.S. Adam, K. Ali, F. Pina-Amargós, J.A. Angulo-Valdés, J. Asher, L.G. Barcia, O. Beaufort, C. Benjamin, A.T.F. Bernard, M.L. Berumen, S. Bierwagen, E. Bonnema, R.M.K. Bown, D. Bradley, E. Brooks, J.J. Brown, D. Buddo, P. Burke, C. Cáceres, D. Cardeñosa, J.C. Carrier, J.E. Caselle, V. Charloo, T. Claverie, E. Clua, J.E.M. Cochran, N. Cook, J. Cramp, B. D’Alberto, M. de Graaf, M. Dornhege, A. Estep, L. Fanovich, N.F. Farabough, D. Fernando, A.L. Flam, C. Floros, V. Fourqurean, R. Garla, K. Gastrich, L. George, R. Graham, T. Guttridge, R.S. Hardenstine, S. Heck, A.C. Henderson, H. Hertler, R. Hueter, M. Johnson, S. Jupiter, D. Kasana, S.T. Kessel, B. Kiilu, T. Kirata, B. Kuguru, F. Kyne, T. Langlois, E.J.I. Lédée, S. Lindfield, A. Luna-Acosta, J. Maggs, B.M. Manjaji-Matsumoto, A. Marshall, P. Matich, E. McCombs, D. McLean, L. Meggs, S. Moore, S. Mukherji, R. Murray, M. Kaimuddin, S.J. Newman, J. Nogués, C. Obota, O. O’Shea, K. Osuka, Y.P. Papastamatiou, N. Perera, B. Peterson, A. Ponzio, A. Prasetyo, L.M.S. Quamar, J. Quinlan, A. Ruiz-Abierno, E. Sala, M. Samoilys, M. Schärer-Umpierre, A. Schlaff, N. Simpson, A.N.H. Smith, L. Sparks, A. Tanna, R. Torres, M.J. Travers, M. van Zinnicq Bergmann, L. Vigliola, J. Ward, A.M. Watts, C. Wen, E. Whitman, A.J. Wirsing, A. Wothke, E. Zarza-González, J.E. Cinner, *Global status and conservation potential of reef sharks*, *Nature*, **583**, 2020, pp. 801–806.
- [3] G.M.S. Vianna, M.G. Meekan, J.L.W. Ruppert, T.H. Bornovski, J.J. Meeuwig, *Indicators of fishing mortality on reef-shark populations in the world’s first shark sanctuary: the need for surveillance and enforcement*, *Coral Reefs*, **35**, 2016, pp. 973–977.

- [4] R.W. Jabado, *The fate of the most threatened order of elasmobranchs: Shark-like batoids (Rhinopristiformes) in the Arabian Sea and adjacent waters*, **Fisheries Research**, **204**, 2018, pp. 448–457.
- [5] R.W. Jabado, P.M. Kyne, R.A. Pollom, D.A. Ebert, C.A. Simpfendorfer, G.M. Ralph, S.S. Al Dhaheri, K. V. Akhilesh, K. Ali, M.H. Ali, T.M.S. Al Mamari, K.K. Bineesh, I.S. El Hassan, D. Fernando, E.M. Grandcourt, M.M. Khan, A.B.M. Moore, F. Owfi, D.P. Robinson, E. Romanov, A.L. Soares, J.L.Y. Spaet, D. Tesfamichael, T. Valinassab, N.K. Dulvy, *Troubled waters: Threats and extinction risk of the sharks, rays and chimaeras of the Arabian Sea and adjacent waters*, **Fish and Fisheries**, **19**, 2018, pp. 1043–1062.
- [6] J. Stevens, *The effects of fishing on sharks, rays, and chimaeras (chondrichthyans), and the implications for marine ecosystems*, **ICES Journal of Marine Science**, **57**, 2000, pp. 476–494.
- [7] R.A. Myers, J.K. Baum, T.D. Shepherd, S.P. Powers, C.H. Peterson, *Cascading effects of the loss of apex predatory sharks from a coastal ocean*, **Science**, **315**, 2007, pp. 1846–1850.
- [8] R.D. Grubbs, J.K. Carlson, J.G. Romine, T.H. Curtis, W.D. Mcelroy, C.T. Mccandless, C.F. Cotton, J.A. Musick, *Critical assessment and ramifications of a purported marine trophic cascade*, **Scientific Reports**, **6**, 2016, pp. 1–12.
- [9] B. Worm, B. Davis, L. Kettener, C. a. Ward-Paige, D. Chapman, M.R. Heithaus, S.T. Kessel, S.H. Gruber, *Global catches, exploitation rates, and rebuilding options for sharks*, **Marine Policy**, **40**, 2013, pp. 194–204.
- [10] B. Davis, B. Worm, *The International Plan of Action for Sharks: How does national implementation measure up?*, **Marine Policy**, **38**, 2013, pp. 312–320.
- [11] R.A. Myers, B. Worm, *Rapid worldwide depletion of predatory fish communities*, **Nature**, **423**, 2003, pp. 280–283.
- [12] G. Roff, C.J. Brown, M.A. Priest, P.J. Mumby, *Decline of coastal apex shark populations over the past half century*, **Communications Biology**, **1**, 2018, pp. 1–11.
- [13] R.W. Jabado, S.M. Al Ghais, W. Hamza, A.C. Henderson, *The shark fishery in the United Arab Emirates: an interview based approach to assess the status of sharks*, **Aquatic Conservation: Marine and Freshwater Ecosystems**, **25**, 2015, pp. 800–816.
- [14] J.L.Y. Spaet, M.L. Berumen, *Fish market surveys indicate unsustainable elasmobranch fisheries in the Saudi Arabian Red Sea*, **Fisheries Research**, **161**, 2015, pp. 356–364.
- [15] V.F. Jaiteh, N.R. Loneragan, C. Warren, *The end of shark finning? Impacts of declining catches and fin demand on coastal community livelihoods*, **Marine Policy**, **82**, 2017, pp. 224–233.
- [16] V.F. Jaiteh, S.J. Lindfield, S. Mangubhai, C. Warren, B. Fitzpatrick, N. Loneragan, *Higher Abundance of Marine Predators and Changes in Fishers' Behavior Following Spatial Protection within the World's Biggest Shark Fishery*, **Frontiers in Marine Science**, **3**, 2016 pp. 1–15.
- [17] R.J. James Catlin, Michael Hughes, Tod Jones, *White sharks in Western Australia: threat or opportunity?*, **Journal of Ecotourism**, **13**, 2014, pp. 159–169.

- [18] B.A. Muter, M.L. Gore, K.S. Gledhill, C. Lamont, C. Huveneers, *Australian and U.S. News Media Portrayal of Sharks and Their Conservation*, **Conservation Biology**, **27**, 2013 pp. 187–196.
- [19] J.R. O’Byrhim, E.C.M. Parsons, *Increased knowledge about sharks increases public concern about their conservation*, **Marine Policy**, **56**, 2015, pp. 43–47.
- [20] A.J. Frisch, M. Ireland, J.R. Rizzari, O.M. Lönnstedt, K.A. Magnenat, C.E. Mirbach, J.P.A. Hobbs, *Reassessing the trophic role of reef sharks as apex predators on coral reefs*, **Coral Reefs**, **35**, 2016, pp. 459–472.
- [21] F. Ferretti, B. Worm, G.L. Britten, M.R. Heithaus, H.K. Lotze, *Patterns and ecosystem consequences of shark declines in the ocean*, **Ecology Letters**, **13**, 2010, pp. 1055–1071.
- [22] D.J. McCauley, H.S. Young, R.B. Dunbar, J.A. Estes, B.X. Semmens, F. Micheli, *Assessing the effects of large mobile predators on ecosystem connectivity*, **Ecological Applications**, **22**, 2012, pp. 1711–1717.
- [23] O.J. Schmitz, D. Hawlena, G.C. Trussell, *Predator control of ecosystem nutrient dynamics*, **Ecology Letters**, **13**, 2010, pp. 1199–1209.
- [24] M.A. Albins, M.A. Hixon, *Worst case scenario: potential long-term effects of invasive predatory lionfish (*Pterois volitans*) on Atlantic and Caribbean coral-reef communities*, **Environmental Biology of Fishes**, **96**, 2013 pp. 1151–1157.
- [25] P. Liza, K. Mustika, M. Ichsan, H. Booth, *The Economic Value of Shark and Ray Tourism in Indonesia and Its Role in Delivering Conservation Outcomes*, **Frontiers in Marine Science**, **7**, 2020, pp. 1–17.
- [26] K.B.J. Glaus, I. Adrian-Kalchhauser, S. Piovano, S.A. Appleyard, J.M. Brunnschweiler, C. Rico, *Fishing for profit or food? Socio-economic drivers and fishers’ attitudes towards sharks in Fiji*, **Marine Policy**, **100**, 2019, pp. 249–257.
- [27] R.W. Jabado, S.M. Al Ghais, W. Hamza, M.S. Shivji, A.C. Henderson, *Shark diversity in the Arabian/Persian Gulf higher than previously thought: insights based on species composition of shark landings in the United Arab Emirates*, **Marine Biodiversity**, **45**, 2015 pp. 719–731.
- [28] R.W. Jabado, J.L.Y. Spaet, *Elasmobranch fisheries in the Arabian Seas Region: Characteristics, trade and management*, **Fish and Fisheries**, **18**, 2017, pp. 1096–1118.
- [29] H. Booth, D. Squires, E.J. Milner-Gulland, *The neglected complexities of shark fisheries, and priorities for holistic risk-based management*, **Ocean and Coastal Management**, **182**, 2019, pp. 1049–1094.
- [30] A.J. Temple, N. Wambiji, C.N.S. Poonian, N. Jiddawi, S.M. Stead, J.J. Kiszka, P. Berggren, *Marine megafauna catch in southwestern Indian Ocean small-scale fisheries from landings data*, **Biological Conservation**, **230**, 2019, pp. 113–121.
- [31] F. Ferretti, D.M.P. Jacoby, M.O. Pflieger, T.D. White, F. Dent, F. Micheli, A.A. Rosenberg, L.B. Crowder, B.A. Block, *Shark fin trade bans and sustainable shark fisheries*, **Conservation Letters**, **13**, 2020, pp. 1–6.
- [32] D.S. Shiffman, N. Hammerschlag, *Shark conservation and management policy: A review and primer for non-specialists*, **Animal Conservation**, **19**, 2016, pp. 1–12.
- [33] H. Bornatowski, R.R. Braga, J.R.S. Vitule, *Threats to sharks in a developing country: The need for effective and simple conservation measures*, **Natureza a Conservacao**, **12**, 2014, pp. 11–18.

- [34] J.M. Drymon, S.B. Scyphers, *Attitudes and perceptions influence recreational angler support for shark conservation and fisheries sustainability*, **Marine Policy**, **81**, 2017, pp. 153–159.
- [35] C. Neff, *The Jaws Effect: How movie narratives are used to influence policy responses to shark bites in Western Australia*, **Australian Journal of Political Science**, **1146**, 2014, pp. 1–14.
- [36] L.A. Friedrich, R. Jefferson, G. Glegg, *Public perceptions of sharks: Gathering support for shark conservation*, **Marine Policy**, **47**, 2014, pp. 1–7.
- [37] C. McCagh, J. Sneddon, D. Blache, *Killing sharks: The media's role in public and political response to fatal human-shark interactions*, **Marine Policy**, **62**, 2015, pp. 271–278.
- [38] D.S. Shiffman, R.E. Hueter, *A United States shark fin ban would undermine sustainable shark fisheries*, **Marine Policy**, **85**, 2017 pp. 138–140.
- [39] D.S. Shiffman, S.J. Bittick, M.S. Cashion, S.R. Colla, L.E. Coristine, D.H. Derrick, E.A. Gow, C.C. Macdonald, M. More O'Ferrall, M. Orobko, R.A. Pollom, J. Provencher, N.K. Dulvy, *Inaccurate and Biased Global Media Coverage Underlies Public Misunderstanding of Shark Conservation Threats and Solutions*, **iScience**, **23**, 2020, pp. 1–32.
- [40] A. Kattan, D.J. Coker, M.L. Berumen, *Reef fish communities in the central Red Sea show evidence of asymmetrical fishing pressure*, **Marine Biodiversity**, **47**, 2017, pp. 1227–1238.
- [41] M. Espinoza, M. Cappo, M.R. Heupel, A.J. Tobin, C.A. Simpfendorfer, *Quantifying Shark Distribution Patterns and Species-Habitat Associations: Implications of Marine Park Zoning*, **PLoS ONE**, **9**, 2014, Article Number: e106885.
- [42] C.W. Speed, M. Cappo, M.G. Meekan, *Evidence for rapid recovery of shark populations within a coral reef marine protected area*, **Biological Conservation**, **220**, 2018, pp. 308–319.
- [43] C.A. Birkmanis, J.C. Partridge, L.W. Simmons, M.R. Heupel, A.M.M. Sequeira, *Shark conservation hindered by lack of habitat protection*, **Global Ecology and Conservation**, **21**, 2020, pp. 1–10.
- [44] J.E.M. Watson, N. Dudley, D.B. Segan, M. Hockings, *The performance and potential of protected areas*, **Nature**, **515**, 2014, pp. 67–73.
- [45] M. Dureuil, K. Boerder, K.A. Burnett, R. Froese, B. Worm, *Elevated trawling inside protected areas undermines conservation outcomes in a global fishing hot spot*, **Science**, **362**, 2018, pp. 1403–1407.
- [46] N.K. Dulvy, C.A. Simpfendorfer, L.N.K. Davidson, S. V Fordham, A. Bräutigam, G. Sant, D.J. Welch, *Challenges and Priorities in Shark and Ray Conservation*, **Current Biology**, **27**, 2017, pp. 565–572.
- [47] R.W. Jabado, S.M. Al Ghais, W. Hamza, A.C. Henderson, J.L.Y. Spaet, M.S. Shivji, R.H. Hanner, *The trade in sharks and their products in the United Arab Emirates*, **Biological Conservation**, **181**, 2015, pp. 190–198.

An overview of Articles 1 to 4 of Ministerial Decree No. [43] for the year 2019 on Regulating the Fishing and Trading of Sharks (United Arab Emirates Ministry of Climate Change & Environment)

Article #	Crux
<p><i>Article_1:</i> <i>Shark Fishing</i></p>	<ul style="list-style-type: none"> • Only fishers whose boats have been marked and entered in the Ministry's general register under the 'lansh' category are permitted to fish for sharks; • Shark hunting season: July 1st – end of February the following year of the following year (denotes that no shark fishing is allowed from March 1st – June 30th); • No more than 100 hooks per lansh line (circular, non-stainless steel hooks (≤12/0 in size)). The fishing gear cord must be made of artificial fibers (Kuralon™), while nylon is prohibited. Gear must be fitted with buoy lights (indicating its location), as well as floating buoys with clear numbers that correspond to the fishing boat number and the code of the Emirate of origin; • Shark fishing is limited to waters that are no less than 8 nautical miles from the shoreline and at least 3 nautical miles away from islands; • Sharks will not be targeted to harvest their fins alone; • No discarding of carcasses or any parts thereof; • Whole sharks with all fins intact must arrive at landing sites; • Fishers who unintentionally catch sharks during the non-hunting season, must release them and ensure precautionary measures to ensure its survival. If not successful, the shark carcasses must be handed over to the competent authority of the Emirate.
<p><i>Article_2:</i> <i>Permanently Banned Sharks</i></p>	<ul style="list-style-type: none"> • Prohibits fishing for any shark species set out in: • Appendix (I) and (II) of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); • Appendix (I) of the Conservation of Migratory Species of Wild Animals (CMS); and • Shark species protected under Federal Law No. [23] for the year 1999, on the Exploitation, Protection and Development of Living Aquatic Resources in the United Arab Emirates and its executive by-laws.
<p><i>Article_3:</i> <i>Imports of Sharks</i></p>	<ul style="list-style-type: none"> • Sharks may be imported in fresh, frozen, dried, salted, smoked, canned or in any other form given that the shipment was supported by the required documents (certificate of origin indicating the scientific name and imported quantity of each species; health certificate; commercial invoice; and packing list of the shipment). • Additional documents (export or re-export certificate from exporting country, incl. a valid CITES import certificate issued by the Ministry) must be submitted in case shark species listed under Article_2 is being imported; • The import of shark fins in any form is prohibited, excl. fins imported for scientific research (needs Ministerial approval).
<p><i>Article_4:</i> <i>Exports/Re-exports of Sharks</i></p>	<ul style="list-style-type: none"> • Imported sharks (and/or shark products) in any form may be re-exported provided that the exporter received a re-export license from the Ministry; • Re-exportation of fins (alone) is prohibited; • Previously (under Ministerial Decree No. [500] for the year 2014) Sharks caught in U.A.E. waters may not be exported in any form (applicable throughout the year). Present-day, local shark export shipments are allowed as long as they comply with current legislation.

(Source: United Arab Emirates Ministry of Climate Change & Environment
<https://www.moccae.gov.ae/assets/download/144a428e/3a4c74dd.pdf.aspx?view=true>)