Trends in
Ecology & Evolution

CellPress

Spotlight

Shark conservation requires mortality-limiting regulations amid global change

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Despite anti-finning laws aimed at conserving sharks, Worm *et al*. have revealed that global shark mortality rates have surprisingly risen over the past decade, driven in large part by increased demand for meat. Here, we discuss the importance of this study, underscoring the need for broader regulations addressing overall shark mortality amid threats from global change.

Since the turn of the century, numerous scientific publications have documented the dramatic and widespread decline of shark populations globally due to overfishing (e.g., [1–3]). Historically, while sharks were being captured as non-target species in some fisheries (e.g., tuna and swordfish longlining and/or shrimp trawls), the greatest driver of shark mortality was targeted removals to fuel the global shark fin trade [4,5]. In most fisheries, shark fins were removed at sea and the dying animal was thrown overboard to make room for more fins, a process known as 'finning' and seen as cruel and wasteful. Accordingly, ending the practice of shark finning became the center of many marine environmental awareness campaigns and conservation focus. Consequently, in the last 20 years many countries have enacted laws preventing shark finning (e.g., finning bans, fin: carcass ratios, requiring fins naturally attached at landing), and/or established trade restrictions and protected areas for sharks, representing a more than tenfold increase in international and national management measures addressing shark conservation [6]. Given significant attention and regulatory management to conserve sharks globally, Worm *et al*. [6] set out to estimate global fishery-induced mortality rates for sharks over the past decade, with a focus on understanding whether shark finning and other regulatory measures have reduced shark mortality.

Wake-up call

Worm *et al*. [6] show that despite growing regulatory change – most notably, the establishment of policies banning shark finning – overall shark mortality has not decreased, but increased. For example, Worm *et al*. [6] report that total fishing mortality of sharks increased from at least 76 million to 80 million sharks between 2012 and 2019, and ~25 million of these were threatened. But how could this be, considering all the regulations established over the last 10+ years? The study reports that while regulations have curtailed the removals of sharks for their fins, sharks are still being killed for their meat and other products. In fact, the demand for shark meat may be increasing given the need to land sharks with their fins, an unintended consequence of finning bans.

This is a huge wake-up call. While the demand for shark fins was historically the greatest threat to sharks, anti-finning regulations did not prevent sharks from being killed, nor did it even prevent fins from being removed and sold, so long as the rest of the shark was not discarded at sea. While it is clear that shark mortality is still high despite these regulations, shark removals in the absence of these anti-finning regulations could have been even greater. It is conceivable that fewer sharks overall were killed given limited storage space on boats and a requirement to land shark carcasses along with their fins versus just fins, meaning a boat-load of fins would have represented many more dead sharks than a boat-load of carcasses. However, the significant underreporting of discarded sharks [7] – those that are caught in fisheries (either dead or alive) but not retained – may contribute to masking the benefits of finning regulations on shark populations.

Complex challenges

It is clear from this study that too many individual sharks are being removed from the world's oceans, and so regulations are needed that limit shark mortality rather than limit the ways in which sharks can be removed or processed, such as in the case of finning bans. A challenge to limiting shark fishing mortality includes the non-selectivity of many gears and fishing vessels operating in areas where target and non-target species overlap [6,7]. This can result in the incidental catches of protected species at levels that will not promote recovery [8] (Box 1). Further, shark removals can be large in artisanal fisheries, but remain largely unregulated, unmonitored, and underreported [6,9].

But fishing does not happen in a vacuum, and threats to sharks need to be considered in the context of climate change and loss of habitat and prey resources, which could exacerbate shark mortality. While not mentioned by Worm *et al*. [6], climate change will likely increase future shark mortality rates if not accounted for. For example, climate-driven deoxygenation of deep waters off West Africa have forced blue sharks (*Prionace glauca*) to surface waters, subsequently increasing fishing mortality [10]. Warming of the Western North Atlantic has induced changes in the distributional range and migratory timing of tiger shark (*Galeocerdo cuvier*) that has reduced their spatial protections from longline fishing [11].

Worm *et al*. [6] note increased shark fishing mortality in coastal waters and increased catch of smaller sharks, including juveniles. This is of particular concern given the disproportionate use of inshore areas by

Box 1. Ongoing bycatch mortality of protected species threatens recovery

Shark bycatch occurs because gears such as industrial pelagic longlines – generally a 100 km long line with ~1000 baited hooks – are not selective for the sharks they catch, which means that endangered, threatened, or protected sharks are still captured and at risk of mortality. For example, the shortfin mako shark, *Isurus oxyrinchus* (Figure I), is commercially important for its meat and fins [8]. In 2017 and 2019, stock assessments of the North Atlantic population determined that it was overfished and subject to overfishing [7]. In 2019 shortfin makos were included in Appendix II of CITES, and in 2021 a 2-year retention ban was agreed for North Atlantic makos. However, shortfin makos are still caught, with around three in ten captured makos dying from interactions with longlines [7]. For the North Atlantic population there is only an estimated 8% chance of stock rebuilding with an annual mortality of 1100 tons [8], which potentially may be exceeded even with zero retention due to bycatch mortality. Reporting bycatch 'discards' (dead or alive) is mandated by regulators, but these appear to be substantially underreported [7]. Proper discard reporting underpinning accurate assessments, as well as measures reducing bycatch mortalities, will be necessary to recover shark populations [6–8].

Figure I. Shortfin mako being hauled aboard a high seas longliner. Photo credit: Marine Biological Association (MBA)/Centre in Biodiversity and Genetic Resources (CIBIO).

critical life-stages: for example, the use of inshore or coastal areas for parturition by pregnant females or as nursery grounds by juveniles. Exacerbating directed mortality to these critical life stages is habitat destruction that occurs in coastal, inshore areas. In addition to the degradation and loss of key habitats, overfishing of shark prey resources is a major threat that is difficult to quantify. But insufficient (or loss of) prey can increase extinction risk to predators [12].

Ocean optimism

While discouraging, the study does report some positive outcomes: namely, regulations that appeared to successfully reduce shark mortality, such as regional shark fishing prohibitions or retention bans, that is, policies that directly reduce the number of sharks being killed. Worm *et al.* [6] also revealed a 7% decline in mortality rates for species listed by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), with retention bans under the oversight of tuna Regional Fisheries Management Organizations (RFMOs). There is concern, however, that discard data of protected species are being underreported, despite being mandatory [6,7]. Nonetheless, there is hope around widespread calls for fuller reporting of shark discards and a more rigorous supervision of by-catch species by RFMOs to address data gaps and to further protect sharks [6,7].

Worm *et al*. [6] highlight the success of small island nations, such as the Bahamas, in effectively reducing shark fishing mortality through spatial protections for sharks. Indeed, the Bahamas is a well-known remaining stronghold for sharks in the Western North Atlantic. While the Bahamas became a shark sanctuary in 2012, shark fishing mortality was already low due to a national ban on longline fishing established in the early 1990s, effectively eliminating the largest source of shark fishing mortality. Indeed, the Bahamas remains one of the last strongholds for shark populations in

the region. An open question remains as to whether the longline fishing ban alone would have had the same impact on shark protection and population recovery as the combination of the longline ban and the sanctuary.

The way forward

As noted by Worm *et al*. [6], shark fishing continues to be a substantial threat to shark populations worldwide, despite anti-finning legislations in many countries. The study demonstrates that regulations are needed which limit the number of sharks being removed from the oceans, which includes area-based conservation, retention bans, catch limits, and bycatch prevention strategies. To ultimately be successful, regulations need to also address loss of habitat and prey resources, while accounting for how a changing climate is affecting fishers' catch rates. The most effective shark conservation strategies will include measures that not only protect sharks but also the ecosystems they depend on, now and into the future.

Declaration of interests

No interests are declared.

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https://doi.org/10.1016/j.tree.2024.03.001

References

1. Baum, J.K. *et al.* (2003) Collapse and conservation of shark populations in the Northwest Atlantic. *Science* 299, 389–392
2. Myers, R.A. *et al.* (2007) Cascading effects of the loss of apex predatory sharks from a coastal ocean. *Science* 315, 1846–1850
3. Dulvy, N.K. *et al.* (2021) Overfishing drives over one-third of all sharks and rays toward a global extinction crisis. *Curr. Biol.* 31, 4773–4787
4. Clarke, S.C. *et al.* (2006) Global estimates of shark catches using trade records from commercial markets. *Ecol. Lett.* 9, 1115–1126
5. Worm, B. *et al.* (2013) Global catches, exploitation rates, and rebuilding options for sharks. *Mar. Policy* 40, 194–204
6. Worm, B. *et al.* (2024) Global shark fishing mortality still rising despite widespread regulatory change. *Science* 383, 225–230
7. Mucientes, G. *et al.* (2022) Unreported discards of internationally protected pelagic sharks in a global fishing hotspot are potentially large. *Biol. Conserv.* 269, 109534
8. Sims, D.W. *et al.* (2021) Shortfin mako sharks speeding to the brink. *Science* 371, 355
9. Hearn, A.R. and Bucaram, S.J. (2017) Ecuador's sharks face threats from within. *Science* 358, 1009
10. Vedor, M. *et al.* (2021) Climate-driven deoxygenation elevates fishing vulnerability for the ocean's widest ranging shark. *eLife* 10, e62508
11. Hammerschlag, N. *et al.* (2022) Ocean warming alters the distributional range, migratory timing, and spatial protections of an apex predator, the tiger shark (*Galeocerdo cuvier*). *Glob. Chang. Biol.* 28, 1990–2005
12. Wolf, C. and Ripple, W.J. (2016) Prey depletion as a threat to the world's large carnivores. *R. Soc. Open Sci.* 3, 160252