

**BEST PRACTICES FOR REDUCING TOTAL MORTALITY OF
NORTH ATLANTIC SHORTFIN MAKO SHARKS**

(Submitted by the United States)

Shortfin mako sharks, *Isurus oxyrinchus*, are globally distributed throughout tropical and temperate seas (Compagno 1984). Females reach maturity at 2.8 m (L_{F50}) (Natanson *et al.* 2020), and current age-at-length metrics estimate this maturity status is reached between 19 and 22 years of age (Natanson *et al.* 2006, Rosa *et al.* 2017). Due to its conservative life history, including late maturity and low reproductive output, the species is vulnerable to population depletion. The 2017 stock assessment for North Atlantic shortfin mako shark found a 90% probability of the stock being overfished and experiencing overfishing. In response, the Commission adopted Recommendation 17-08, which contained measures designed to stop overfishing and begin to rebuild the stock. In 2019, the SCRS carried out new projections for the stock through 2070 (two mean generation times) at the Commission's request and produced a Kobe II Strategy Matrix. The species' conservative life history characteristics contribute to a significant lag time that can be expected between when a TAC is implemented and when the spawning stock biomass begins to increase. To accelerate the rate of recovery and to increase the probability of success, the SCRS recommended that the Commission adopt a no-retention policy without exception in the North Atlantic. However, due to at-vessel and post-release mortality, a simple no-retention requirement is not expected to reduce mortality enough to stop overfishing and rebuild the stock. Additional efforts are needed with a focus on the needed mortality reductions; the SCRS has suggested that gear modifications and time/area closures along with safe handling and release practices have the potential to further reduce mortality and support rebuilding.

The reduction of at-haulback and post-release mortality for the shortfin mako has been the focus of numerous SCRS papers. In SCRS/2019/091, Rosa *et al.* presented a meta-analysis of retention and at-haulback mortality rates for elasmobranchs that compared different hook, bait, and leader types in the surface pelagic longline fishery. The Sub-Committee noted that although catch rates using circle hooks were reported to be higher for sharks, this could be due to bite-offs, which is believed to occur more often on J-hooks. The reason is that relative to circle hooks, J-hooks tend to result more often in deep hooking (e.g., in the gut) making bite-offs more likely to occur. In addition, with regard to shortfin mako, the Shark Species Group noted that with circle hooks the retention rate would increase, but at-haulback mortality would decrease compared to J-hooks. SCRS/2020/056 (Keller *et al.* 2020) detailed a scientific review of the available research on catch statistics for the shortfin mako. There was no clear trend in catch rates by hook type, but shortfin mako were significantly less likely to be gut-hooked with circle hooks. SCRS/2020/39 (Diaz 2020) demonstrated that at-haulback mortality was significantly lower for shortfin mako when circle hooks were used. These two papers resulted in the Sub-Committee on Ecosystems stating the "use of circle hooks in longline fisheries increases the at-haulback survival of shortfin mako shark" and led the Sub-Committee to reiterate its recommendation from 2019 that the Commission should adopt the use of circle hooks for shallow longline sets.

In 2010, the United States began promoting the live release of shortfin mako sharks. At the same time, we started advocating for international management measures to address overfishing of this stock. Such international cooperation is essential since the United States is responsible for only a small portion of North Atlantic shortfin mako mortality and could not end overfishing on its own. The United States has since implemented stricter measures on its ICCAT fisheries in accordance with subsequent ICCAT recommendations, including Recommendation 17-08 (later replaced by Rec 19-06). U.S. measures have been extremely effective in reducing North Atlantic shortfin mako mortality in our fisheries. Current U.S. management of North Atlantic shortfin mako shark, including use of fishing gears that reduce shark mortality, are described below.

How has the United States reduced North Atlantic shortfin mako shark mortality?

- Through a combination of measures, the United States has successfully reduced landings of shortfin mako by more than 80% since SCRS determined the stock was overfished in 2017.

- Within our own fisheries, reducing bycatch and bycatch mortality has long been a priority for the United States. The United States has used circle hooks domestically for 15+ years in our pelagic longline fisheries. In 2017 (82 FR 16478), the United States expanded upon the specific information on the safe handling and release practices required to mitigate shark bycatch as part of workshops that were already required for the safe handling and release of sea turtles and other protected species in this fishery. Additionally, in that same action, the United States began requiring circle hooks in recreational rod and reel and handline fisheries and bottom longline fisheries for sharks.
- In 2015, the United States implemented a requirement for all pelagic longline vessels to install a functioning electronic monitoring system (regardless of vessel length). Since 2018, U.S. fishermen have been required to release any live shortfin mako shark if the shark is caught on commercial fishing gear. Pelagic longline fishermen are allowed to retain shortfin mako sharks that are dead at haulback (consistent with ICCAT Recommendations 17-08 and 19-06). Retention of dead shortfin mako sharks with pelagic longline gear is allowed only if there is a functional electronic monitoring system on board the vessel. Video from the vessels is reviewed and any violations of regulations are subject to fines or other enforcement action. To date, compliance with U.S. regulations has been high.
- All commercial fishermen must obtain a fishing permit and submit commercial logbooks to the National Marine Fisheries Service. In addition to the requirement to install electronic monitoring systems and vessel monitoring systems, vessels must carry observers, if selected. The observer coverage of the U.S. pelagic longline fleet was 10.5 percent of the fishing sets in 2019. Dealers must be federally permitted and report all shark landings by species.
- In Atlantic U.S. longline fisheries, monofilament leaders are almost exclusively used. This is not a regulatory requirement, rather U.S. fishermen use monofilament by choice. This practice has the added benefit of decreasing shark bycatch and mitigating shark mortality.
- In recreational fisheries, generally only one shark may be retained per vessel per trip. If that shark is a shortfin mako, it must have a minimum size of 71 inches (180 cm) fork length for males and 83 inches (210 cm) fork length for females. In addition, the United States promotes safe handling and live release of shortfin mako and other sharks through education and outreach efforts, including a required video and quiz, brochures, and compliance guides.
- Recreational fishermen are required to report shark landings via recreational fishing survey when contacted. All fishing tournaments for highly migratory species are required to report landings and discards.
- Shortfin mako that are landed must have their fins naturally attached through offloading.

Why are circle hooks so important for reducing total mortality of the shortfin mako?

- Numerous SCRS papers have documented that circle hooks increase at-haulback survival for the shortfin mako. These papers have also shown that circle hooks use results in less gut-hooking, which is believed to decrease post-release mortality.
- The SCRS noted that, although catch rates using circle hooks were reported in some studies to be higher for sharks, this could be due to fewer bite-offs.
- Circle hooks also increase at-haulback survival of bycatch species in longline fisheries, including billfish, undersized swordfish, and loggerhead sea turtles.

What are the advantages of monofilament leaders over wire leaders?

- In 2017, the SCRS noted that the use of monofilament instead of steel traces or wire leaders is known to be effective at reducing shark bycatch in longline fisheries. In addition, a number of studies presented at tuna RFMO meetings have concluded that shark catch rates on longline gear, including shortfin mako shark catch rates, are lower on monofilament leaders compared to wire leaders. These studies further conclude that the use of monofilament leaders is an effective method for reducing shark bycatch and mitigating shark mortality in longline fisheries. This is likely a result of increased bite-offs when monofilament leaders are used instead of steel.

The United States believes that using a combination of circle hooks, monofilament leaders, and education and outreach relative to safe handling and release constitute the best practices for reducing at-vessel and post-release mortality for sharks, including shortfin mako sharks. Using these methods in addition to strict limits on retention (e.g., retention allowed only if the shark is dead at haul back or if the shark has reached at least the ICCAT minimum size) will allow shortfin mako sharks to rebuild, consistent with the SCRS advice. Such measures will also ensure the fishery is not wasteful, as any dead sharks could be retained, counted in future stock assessments, and have biological data collected from them. A measure that only prohibits retention without reducing at-vessel or post-release mortality would result, at best, in slow rebuilding of the stock and ultimately may not achieve rebuilding to the Convention objective. For more information on U.S. regulations implementing ICCAT recommendations on shortfin mako sharks, please see the U.S. Shark Implementation Check Sheet.

Works Cited

- Compagno, L.J.V. (1984). FAO species catalogue. Vol 4. Sharks of the world. An annotated and illustrated catalogue of shark species known to date. Part 1 - Hexanchiformes to Lamniformes. FAO. Fish. Synop., Vol. 4, Pt. 1, 1-250
- Diaz, G.A. (2020). The effect of circle hooks vs J hooks on the at-haulback survival in the U.S. Atlantic Pelagic longline fleet. Collective Volume of Scientific Papers, ICCAT, 77 (4), 127-136
- Keller, B.A., Swimmer, Y., Brown, C.A. (2020). Review on the effect of hook type on the catchability, hooking location, and post-capture mortality of the shortfin mako, *Isurus Oxyrinchus*. Collective Volume of Scientific Papers, ICCAT, 77 (4), 240-251
- Natanson, L. J., Kohler, N.E., Ardizzone, D., Cailliet, G.M., Wintner, S.P., Mollet, H.F. (2006). Validated age and growth estimates for the shortfin mako, *Isurus oxyrinchus*, in the North Atlantic Ocean. Environmental Biology of Fishes, 77: 367–383
- Natanson, L.J., Winton, M., Bowlby, H., Joyce, W., Deacy, B., Coelho, R., Rosa. D. (2020). Updated reproductive parameters for the shortfin mako (*Isurus oxyrinchus*) in the North Atlantic Ocean with inferences of distribution by sex and reproductive stage. Fishery Bulletin, 118: 21–36
- Rosa, D, Santos, C.C., Coelho, R. (2020). Assessing the Effects of Hook, Bait and Leader Type As Potential Mitigation Measures To Reduce Bycatch and Mortality Rates of Shortfin Mako: A Meta-Analysis With Comparisons for Target, Bycatch and Vulnerable Fauna Interactions. Collective Volume of Scientific Papers, ICCAT, 76: 247–78