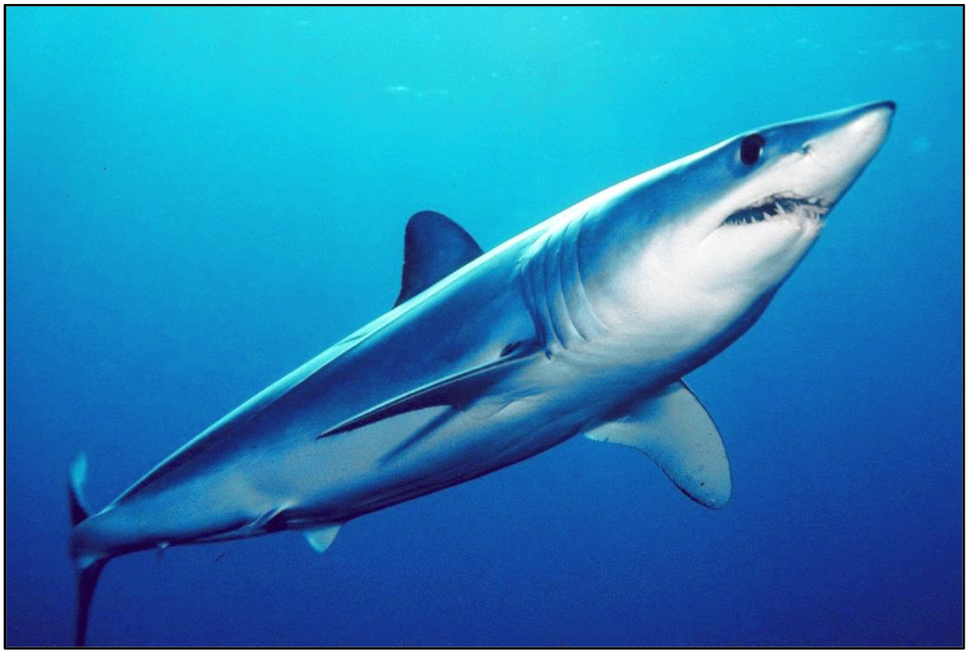
Petition to List the Shortfin Mako Shark (*Isurus oxyrinchus*) as Endangered or Threatened Under the Endangered Species Act



Shortfin mako shark. Photo (public domain):
Mark Conlin, SWFSC Large Pelagics Program.

Submitted to the U.S. Secretary of Commerce
acting through the National Oceanic and Atmospheric Administration
and the National Marine Fisheries Service

January 25, 2021

Defenders of Wildlife

NOTICE OF PETITION

January 25, 2021

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Dear Secretary of Commerce:

Pursuant to the Endangered Species Act ("ESA"), 16 U.S.C. § 1533(b), the Administrative Procedure Act, 5 U.S.C. § 553(e), and the ESA's implementing regulations, 50 C.F.R. § 424.14, Defenders of Wildlife formally petitions the Secretary of Commerce to list the shortfin mako shark (*Isurus oxyrinchus*) as an endangered or threatened species and to designate critical habitat concurrent with the listing.

This Petition sets in motion a specific process, placing definite response requirements on the Secretary of Commerce and the National Marine Fisheries Service ("NMFS"), an agency within the National Oceanic and Atmospheric Administration ("NOAA"), by delegation. Specifically, NMFS must issue an initial finding as to whether the Petition "presents substantial scientific or commercial information indicating that the petitioned action may be warranted." 16 U.S.C. § 1533(b)(3)(A). NMFS must make this initial finding "[t]o the maximum extent practicable, within 90 days after receiving the petition." *Id.* Petitioners need not demonstrate that listing is warranted; rather, petitioners must only present information demonstrating that listing may be warranted. While petitioners believe that the best available scientific data demonstrates that listing the shortfin mako shark as endangered is in fact warranted, there can be no reasonable dispute that the available information indicates that listing this species as either endangered or threatened throughout all or a significant portion of its range may be warranted. NMFS must promptly make an initial finding on the Petition and commence a status review as required by 16 U.S.C. § 1533(b)(3)(B).

As required by 50 C.F.R. § 424.14(b), Defenders provided written notice (via email) to the state and territory agencies responsible for the management and conservation of the shortfin mako shark on June 22, 2020, more than 30 days prior to the submission of this Petition. A copy of the notice accompanies this Petition. *See* 50 C.F.R. § 424.14(c)(9). We anticipate that, in keeping with 50 C.F.R. § 424.14(f)(2), NMFS will acknowledge the receipt of this Petition within a reasonable timeframe. As fully set forth below, this Petition contains all the information requested in 50 C.F.R. § 424.14(c)–(e) and 16 U.S.C. § 1533(e). All cited documents are listed in the Literature Cited section; electronic copies of these documents accompany this Petition; and pinpoint citations to these have been provided where appropriate. *See* 50 C.F.R. § 424.14(c)(5)–(6).

Petitioner Defenders of Wildlife ("Defenders") is a non-profit conservation organization dedicated to the protection of all native animals and plants in their natural communities. Defenders' 2019–2028 Strategic Plan identifies marine species, including sharks and rays, as one of several key groups of species whose conservation is a priority for our organization's work.[1] Defenders uses science, education, litigation, and research to protect wild animals and plants. Known for our effective leadership on endangered species issues, Defenders also advocates for new approaches to wildlife conservation to protect species before they become endangered. Our programs reflect the conviction that saving the biodiversity of our planet requires protecting entire ecosystems and ensuring interconnected habitats. Founded in 1947, Defenders of Wildlife is a 501(c)(3) membership organization with more than 1.4 million members and supporters nationwide.

If you have any questions, please feel free to contact us via the information contained in the signature blocks below.

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[1] More information on Defenders' work is available at https://www.defenders.org and Defenders' 2019–2028 Strategic Plan is available at https://defenders.org/sites/default/files/2019-06/Defenders-of-Wildlife-2019-2028-Strategic-Plan.pdf.

ACKNOWLEDGMENTS

Defenders of Wildlife thanks Cecilia Diedrich of the Conservation Law Program and Jennie Miller of the Center for Conservation Innovation for co-authoring the Petition. Defenders also thanks staff members Jane Davenport, Alejandra Goyenechea, Jacob Malcom, and Andrew Carter, and students Eric Hughes (Cornell University, College of Agriculture and Life Sciences), Phalen Kohlruss-Reuman (University of California, Berkeley School of Law), and Colleen McGee (American University) for their invaluable contributions.

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EXECUTIVE SUMMARY

The shortfin mako shark (*Isurus oxyrinchus*) is a large pelagic species and the fastest shark in the world. The species is highly migratory and has a geographical range that extends throughout the world's tropical and temperate ocean waters.

Due to the commercial value of its meat and fins, the shortfin mako is fished throughout its range as target catch and bycatch in coastal and pelagic fisheries. Overfishing of the species has resulted in steep population declines in the North and South Atlantic Ocean and slightly more moderate declines in the North Pacific Ocean and Indian Ocean. The International Union for Conservation of Nature recently assessed the shortfin mako as "endangered" on the Red List of Threatened Species, estimating the global population trend (weighted according to the relative size of each region) to have experienced a median reduction of 46.6% with the highest probability of a reduction of 50–79% over three generation lengths (72–75 years).

The Endangered Species Act ("ESA") states that a species shall be determined to be endangered or threatened in all or a significant portion of its range based on any one or combination of five factors. *See* 16 U.S.C. § 1533(a)(1). The shortfin mako shark faces threats under one or more of the five listing factors, and the cumulative effects thereof, that warrant listing it as an endangered or threatened species in all or a significant portion of its range.

Modification of habitat or range. The ever-increasing pollution of our oceans threatens the survival of the shortfin mako. Due to the species' high trophic position, long life, and large size, environmental pollutants—including polychlorinated biphenyls ("PCBs"), mercury, and pesticides—bioaccumulate and biomagnify to tremendously high levels in shortfin mako sharks causing negative physiological impacts.

Overutilization. Overfishing is the greatest threat facing the shortfin mako. The species is valued for its high-quality meat, fins, and other products and is targeted and retained as bycatch in coastal and pelagic commercial fisheries worldwide. Like many shark species, the shortfin mako is also threatened by finning practices (discarding shark bodies after removing the fins), hooking (unintentional capture), and post-release mortality. In addition, shortfin mako sharks are a prize for recreational fishers seeking to catch the world's fastest shark.

Inadequacy of existing regulatory mechanisms. While the conservation of sharks is becoming an increasing global priority, commercial demand for shortfin mako parts and products has caused a reluctance to protect the species. A patchwork of shark finning bans, catch and retention limitations, trade regulations, and marine habitat protections have provided some protections for the shortfin mako, but have been inadequate to conserve this highly migratory species as demonstrated by its severe decline.

Other natural or manmade factors. There are other factors that may affect the continued existence of the shortfin mako. Climate change is one factor that impacts the species both directly and indirectly. Warming oceans may affect the spatial and temporal distribution of the shortfin mako and its prey, as well as cause an increase in harmful neurotoxicants and ocean acidity that affect the species' hunting ability and embryotic and hatchling survival.

Cumulative effects. The cumulative and synergistic effects of the numerous threats that the shortfin mako faces, compounded by its low reproductive rate, has brought the species to the point where ESA listing may be warranted and constrains the species' ability to recover quickly from dramatic population declines.

Based on the factors outlined above, the shortfin mako shark warrants listing under the ESA.

I. INTRODUCTION

Defenders formally petitions the Secretary of Commerce ("Secretary"), acting through the National Marine Fisheries Service ("NMFS"), an agency within the National Oceanic and Atmospheric Administration ("NOAA"), to list the shortfin mako shark (*Isurus oxyrinchus*) as endangered or threatened under the Endangered Species Act ("ESA") and to designate critical habitat for the species within U.S. waters. *See* 16 U.S.C. §§ 1531–1544.

In reviewing the shortfin mako's status, NMFS must analyze whether the species warrants listing as endangered or threatened throughout all or any significant portion of its range. 16 U.S.C. § 1532(6), (20). If NMFS finds that there are distinct population segments ("DPSs") of shortfin mako, it must evaluate each of those DPSs for listing under the ESA.[2]

If NMFS determines to list the shortfin mako or any DPS thereof as threatened, Defenders petitions the agency to promulgate a final 4(d) rule to confer full take protections on the species concurrent with final listing. *See* 16 U.S.C. § 1533(d). Those protections are necessary and advisable to provide for the conservation of the species. Further, if the shortfin mako or any DPS thereof is listed as endangered or threatened, Defenders also petitions NMFS to promulgate a 4(e) rule for species similar in appearance to the shortfin mako, specifically the longfin mako shark (*Isurus paucus*). As set forth in 50 C.F.R. § 424.14(j), "[t]he Services will conduct a review of petitions to . . . adopt a rule under section 4(d) [or] 4(e) . . . of the [ESA] in accordance with the Administrative Procedure Act (5 U.S.C. [§] 553) and applicable Departmental regulations, and take appropriate action."

This Petition is submitted pursuant to the ESA, 16 U.S.C. § 1533(b)(3)(A), the ESA's implementing regulations, 50 C.F.R. § 424.14, and the Administrative Procedure Act, 5 U.S.C. § 553(e). As required by 50 C.F.R. § 424.14(b), Defenders provided written notice (via email) to the state and territory agencies responsible for the management and conservation of the shortfin mako on June 22, 2020, more than 30 days prior to the submission of this Petition. A copy of the notice accompanies this Petition. *See* 50 C.F.R. § 424.14(c)(9). We anticipate that, in keeping with 50 C.F.R. § 424.14(f)(2), NMFS will acknowledge the receipt of this Petition within a reasonable timeframe. As fully set forth below, this Petition contains all the information requested in 50 C.F.R. § 424.14(c)–(e) and 16 U.S.C. § 1533(e). All cited documents are listed in the Literature Cited section; electronic copies of these documents accompany this Petition; and pinpoint citations to these have been provided where appropriate. *See* 50 C.F.R. § 424.14(c)(5)–(6).

II. GOVERNING PROVISIONS OF THE ENDANGERED SPECIES ACT

A. Species and Distinct Population Segments

The ESA defines the term "species" to include "any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." 16 U.S.C. § 1532(16). NMFS and the U.S. Fish and Wildlife Service ("FWS") have published a joint DPS policy, 61 Fed. Reg. 4722 (Feb. 7, 1996), which allows the agencies to protect

[2] Should NMFS determine that shortfin mako DPSs do in fact exist and that those DPSs warrant ESA designation, then Defenders requests that NMFS analyze whether those DPSs represent a significant portion of the species' range such that listing of the species as a whole is appropriate.

and conserve vertebrate species, such as the shortfin mako, under the ESA on a regional basis. This DPS policy provides criteria for DPS analysis. To satisfy the DPS criteria, a vertebrate species population must be discrete from other populations of the species and significant to the species. Therefore, if NMFS determines that the shortfin mako may not warrant listing throughout its range, it should use these criteria to determine whether any DPSs can be identified and may warrant listing.

B. Significant Portion of a Species' Range

The ESA defines an "endangered species" as any species that is "in danger of extinction throughout all or a significant portion of its range," 16 U.S.C. § 1532(6), and a "threatened species" as one that "is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." 16 U.S.C. § 1532(20).

In 2014, NOAA and FWS issued their most recent policy on the interpretation of the "significant portion of its range" ("SPR") language. 79 Fed. Reg. 37,577 (July 1, 2014). The policy's definition of "significant portion" provides that "a portion of the range of a species is 'significant' if the species is not currently endangered or threatened throughout all of its range, but the portion's contribution to the viability of the species is so important that, without the members in that portion, the species would be in danger of extinction, or likely to become so in the foreseeable future, throughout all of its range." *Id.* at 37,579. Courts have since deemed the SPR policy's definition of "significant" to be "inconsistent with the ESA." *See*, *e.g.*, *Ctr. for Biological Diversity v. Everson*, 435 F. Supp. 3d 69, 92 (D.D.C. Jan. 28, 2020) (citations omitted). Further, because of the numerous legal challenges to and vacatur of different aspects of the SPR policy, it cannot be relied upon. *See*, *e.g.*, *id.* at 98 (vacating the provision of the final SPR policy that provides "if the Services determine that a species is threatened throughout all of its range, the Services will not analyze whether the species is endangered in a significant portion of its range"); *Friends of Animals v. Ross*, 396 F. Supp. 3d 1, 10 (D.C. Cir. 2019) (citations omitted) (vacating and setting aside the listing decision because the agency relied on the now-vacated SPR policy).

Therefore, under any reasonable interpretation of the ESA, NMFS must consider whether a species is endangered throughout all or a significant portion of its range or threatened throughout all or a significant portion of its range. If NMFS determines that the petitioned species is endangered in a significant portion of its range, then the species should be listed as endangered throughout its range. If NMFS determines that the petitioned species is threatened in a significant portion of its range (and not endangered in any significant portion of its range), then the species should be listed as threatened throughout its range. *See generally Defenders of Wildlife v. Norton*, 258 F.3d 1136, 1141–42 (9th Cir. 2001); 79 Fed. Reg. at 37,579–80 (citing *Norton*, 258 F.3d 1136 (giving operational meaning to the words on either side of the "or")).

C. Listing Factors

NMFS must make its determination of whether a species is endangered or threatened based solely on one or more of the five factors set forth in 16 U.S.C. § 1533(a)(1):

(A) the present or threatened destruction, modification, or curtailment of its habitat or range;
(B) overutilization for commercial, recreational, scientific, or educational purposes;
(C) disease or predation;

(D) the inadequacy of existing regulatory mechanisms; or
(E) other natural or manmade factors affecting its continued existence.

16 U.S.C. § 1533(a)(1)(A)–(E); 50 C.F.R. § 424.11(c)(1)–(5).

D. 90-Day and 12-Month Findings

"To the maximum extent practicable," NMFS is required to determine "whether the petition presents substantial scientific or commercial information indicating that the petitioned action may be warranted" within 90 days of receiving a petition to list a species. 16 U.S.C. § 1533(b)(3)(A). This is referred to as a "90-day finding." A "negative" 90-day finding ends the listing process and is a final agency action subject to judicial review. 16 U.S.C. § 1533(b)(3)(C)(ii). A "positive" 90-day finding leads to a formal, more comprehensive "status review" and a "12-month finding" determining, based on the best available scientific and commercial data, whether listing the species is warranted, not warranted, or warranted but precluded by other pending listing proposals for higher priority species. 16 U.S.C. § 1533(b)(3)(B). "Not warranted" and "warranted but precluded" 12-month findings are also subject to judicial review. 16 U.S.C. § 1533(b)(3)(C)(ii).

The ESA's implementing regulations define "substantial information," for the purpose of a 90-day finding, as "credible scientific or commercial information in support of the petition's claims such that a reasonable person conducting an impartial scientific review would conclude that the action proposed in the petition may be warranted." 50 C.F.R. § 424.14(h)(1)(i).

> [NMFS's] determination as to whether the petition provides substantial scientific or commercial information indicating that the petitioned action may be warranted will depend in part on the degree to which the petition includes the following types of information:
>
> (1) Information on current population status and trends and estimates of current population sizes and distributions, both in captivity and the wild, if available;
> (2) Identification of the factors under section 4(a)(1) of the Act that may affect the species and where these factors are acting upon the species;
> (3) Whether and to what extent any or all of the factors alone or in combination identified in section 4(a)(1) of the Act may cause the species to be an endangered species or threatened species (i.e., the species is currently in danger of extinction or is likely to become so within the foreseeable future), and, if so, how high in magnitude and how imminent the threats to the species and its habitat are;
> (4) Information on adequacy of regulatory protections and effectiveness of conservation activities by States as well as other parties, that have been initiated or that are ongoing, that may protect the species or its habitat; and
> (5) A complete, balanced representation of the relevant facts, including information that may contradict claims in the petition.

50 C.F.R. § 424.14(d).

E. Reasonable Person Standard

Establishing the "reasonable person" standard for the substantial information determination, the ESA's implementing regulations and relevant case law demonstrate that "a petition need not establish a 'strong likelihood' or a 'high probability' that a species is either threatened or endangered to support a positive 90-day finding." *See* 79 Fed. Reg. 4877 (Jan. 30, 2014); *see also* 50 C.F.R. § 424.14(h)(1); *Am. Stewards of Liberty v. U.S. Dep't of the Interior*, 370 F. Supp. 3d 711, 717, 726 (W.D. Tex. 2019) ("Though 'substantial scientific and commercial information' may seem like a high bar, . . . the Service's regulations indicate otherwise . . . ."). In reviewing negative 90-day findings, the evidentiary threshold at the 90-day review stage is much lower than the one required under a 12-month review.

Courts have characterized the 90-day finding determination as a mere "threshold determination" and have held that it contemplates a "lesser standard by which a petitioner must simply show that the substantial information in the Petition demonstrates that listing of the species may be warranted." *See Humane Soc'y of the U.S. v. Pritzker*, 75 F. Supp. 3d 1, 15 (D.D.C. 2014) (quoting *Colo. River Cutthroat Trout v. Kempthorne*, 448 F. Supp. 2d 170, 176 (D.D.C. 2006)); *see generally* 16 U.S.C. § 1533(b)(3)(A). Accordingly, a petition does not need to establish that there is a high likelihood that a species is either endangered or threatened to trigger a positive 90-day finding.

F. Best Available Scientific and Commercial Data

NMFS is required to make a 90-day finding on the Petition based solely on the best available scientific and commercial data. *See* 16 U.S.C. § 1533(b)(1)(A); 50 C.F.R. § 424.11(b). Therefore, NMFS cannot deny listing merely because there is little information available, if the best available information indicates that a species may warrant listing as endangered or threatened under any one or any combination of the five ESA listing factors. This is particularly important during the 90-day review because, as noted above, NMFS must make a positive 90-day finding and commence a status review when a "reasonable person" would conclude, based on the available evidence, that listing may be warranted.

1. International Scientific and Commercial Data

The International Union for Conservation of Nature ("IUCN") is the world's oldest and largest global environmental network and has become a leading authority on the environment. It is a neutral, democratic membership union with more than 1,400 government and non-governmental organization ("NGO") members, and more than 17,000 volunteer scientists and experts active in more than 160 countries (IUCN webpage 2021). Its work is supported by about 900 professional staff and has offices in more than 50 countries, plus hundreds of partners in public, NGO, and private sectors around the world (IUCN webpage 2021).

As part of its work, the IUCN compiles and updates the IUCN Red List, which "has evolved to become the world's most comprehensive information source on the global extinction risk status of animal, fungus[,] and plant species" (IUCN Red List webpage 2021). The IUCN Red List assessments are recognized internationally, are relied on in a variety of scientific publications, and are used by numerous governmental organizations and NGOs. The IUCN Red List has also been used to inform multilateral agreements, such as the Convention on International Trade in Endangered

Species of Wild Fauna and Flora ("CITES"), the Convention on the Conservation of Migratory Species of Wild Animals ("CMS"), and the Convention on Biological Diversity.

As a result of the scientific rigor with which Red List species extinction risk determinations are made, both NMFS and FWS have utilized IUCN Red List data and listing determinations when making ESA listing decisions even though the criteria differ from the ESA's statutory requirements for listing a species as endangered or threatened. *See* 50 C.F.R. § 424.11(f). This is because the IUCN Red List is considered a credible source of scientific data that meets the "best scientific and commercial data" requirement of the ESA. *See* 16 U.S.C. § 1533(b)(1)(A).

The appropriateness of relying on the IUCN Red List as evidence that a species is endangered or threatened is further supported by a study that found that, with respect to marine fish species, IUCN Red List listings were not biased towards exaggerating threat status and that IUCN Red List listings can serve as an accurate flag for relatively data-poor fisheries (Davies & Baum 2012, at 7). In fact, based on the listing criteria that must be evaluated and applied, the IUCN Red List is an even more objective evaluation of a species' extinction risk than the more subjective narrative criteria used in the ESA listing process.

The IUCN Red List has assessed the shortfin mako as an "endangered" species, with declining populations in all oceans except one (Rigby et al. 2019, at 1, 5). Notably, the IUCN assessment was made November 5, 2018 and published in 2019, and threats to the species as well as population decline have continued since (Rigby et al. 2019, at 1). The IUCN specifically stated:

> To allow recovery, it is recommended Shortfin Mako landings be prohibited as long as the global population is classified as Endangered. Short of that, improved reporting of catch and discard data, regional and national limits on Shortfin Mako catch based on scientific advice and/or the precautionary approach, and promotion of safe release protocols are urgently needed, as is full implementation of additional commitments agreed through international treaties.

(Rigby et al. 2019, at 6). Therefore, the IUCN classification and determinations constitutes a source of credible evidence to satisfy the reasonable person standard for a positive 90-day finding on this petition.

2. Species Protected by International Agreement

Pursuant to 50 C.F.R. § 424.11(f), "The Secretary shall give consideration to any species protected under such an international agreement, or by any State or foreign nation, to determine whether the species is endangered or threatened."

> The fact that a species of fish, wildlife, or plant is protected by the Convention on International Trade in Endangered Species of Wild Fauna and Flora . . . or a similar international agreement on such species, or has been identified as requiring protection from unrestricted commerce by any foreign nation, or to be in danger of extinction or likely to become so within the foreseeable future by any State agency or by any agency of a foreign nation that is responsible for the conservation of fish, wildlife, or plants, may constitute evidence that the species is endangered or threatened. The weight given such evidence will vary depending on the international

agreement in question, the criteria pursuant to which the species is eligible for protection under such authorities, and the degree of protection afforded the species.

50 C.F.R. § 424.11(f). As detailed below in Section IV.D.3.c. Convention on International Trade in Endangered Species of Wild Fauna and Flora, the shortfin mako shark is listed under CITES Appendix II. The CITES Appendix II listing and the data supporting the states parties' decision to add the shortfin mako shark to Appendix II constitute a source of credible evidence to satisfy the reasonable person standard for a positive 90-day finding on this Petition.

G. Protective Regulations for Threatened Species

Section 4(d) of the ESA directs NMFS to issue regulations that are necessary and advisable to conserve species listed as threatened. *See* 16 U.S.C. § 1533(d). When a species is listed as threatened as opposed to endangered, the prohibitions identified in section 9 of the ESA do not automatically apply to that species. *See* 16 U.S.C. § 1538. Under section 9 of the ESA, it is unlawful to import, export, or take endangered species for any purpose, including commercial activity. The term "take" means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. 16 U.S.C. § 1532(19). The term "harm" is defined as any act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering. 50 C.F.R. § 222.102. The ESA prohibits any take of species listed as endangered, but some take of threatened species that does not interfere with survival and recovery may be allowed.

For threatened species, NMFS can issue regulations under section 4(d) of the ESA to extend some, or all, of the section 9 prohibitions (*see* Section VI. Protective Regulations for Threatened Species (petition to adopt a 4(d) rule pursuant to 50 C.F.R.§ 424.14(j)). In issuing a 4(d) rule, NMFS considers the species' biological status, conservation needs, and threats and determines which activities need to be regulated or prohibited in order to conserve the species.

H. Similarity of Appearance Determinations

Section 4(e) of the ESA allows the designation of a species that is not endangered or threatened but closely resembles an endangered or threatened species to be listed if NMFS determines that listing is advisable. To address problems associated with similar-looking species, Congress created the Similarity of Appearance clause of the ESA, which states:

> The Secretary may, by regulation of commerce or taking, and to the extent he deems advisable, treat any species as an endangered species or threatened species even though it is not listed pursuant to this section if he finds that—
> (A) such species so closely resembles in appearance, at the point in question, a species which has been listed pursuant to such section that enforcement personnel would have substantial difficulty in attempting to differentiate between the listed and unlisted species;
> (B) the effect of this substantial difficulty is an additional threat to an endangered or threatened species; and
> (C) such treatment of an unlisted species will substantially facilitate the enforcement and further the policy of this chapter.

16 U.S.C. § 1533(e).

Most similarity of appearance listings have been the result of either NMFS's or FWS's (collectively, "the Services") own initiative or in response to comments on proposed listing rules. Generally, the Services have referred to a combination of scientific and commercial experts, lay people, and additional scientific information to determine whether a species of similar appearance warrants listing. *See, e.g.*, Final Rule to List the Giant Manta Ray as Threatened Under the Endangered Species Act, 83 Fed. Reg. 2916 (Jan. 22, 2018); Notice of 12-Month Finding on Petition to List the Smooth Hammerhead Shark as Threatened or Endangered Under the Endangered Species Act, 81 Fed. Reg. 41,934 (Jun. 28, 2016).

The factor typically given the most weight is the impact the similarities may have on the enforceability of take penalties, specifically the ability to effectively distinguish between species or parts of species (e.g., fins, oil, meat, leather, etc.). *See, e.g., id.* The Services have listed both separate species as well as subspecies and/or DPSs based on similarity of appearance. *See, e.g.*, Listing the Scarlet Macaw, 84 Fed Reg. 6278 (Feb. 26, 2019) (listing the southern scarlet macaw DPS based on similarity to the northern DPS); Listing the Southern White Rhino (*Ceratotherium simum simum*) as Threatened, 79 Fed. Reg. 28,847 (May 20, 2014) (listing the southern white rhino based on the similarity of appearance of its horn to those of numerous endangered rhino species). If species identification issues exist, NMFS can promulgate a 4(e) rule for species similar in appearance in to a listed species in order to provide for the conservation of the listed species (*see* Section VII. Similarity of Appearance Determination (petition to adopt a 4(e) rule pursuant to 50 C.F.R.§ 424.14(j)).

III. SPECIES DESCRIPTION

A. Common Name

This Petition will refer to *Isurus oxyrinchus* by the common name "shortfin mako" or "shortfin mako shark" throughout. Other common names include the blue pointer and bonito shark (NOAA Atlantic Shortfin Mako Shark Overview webpage 2021).

B. Taxonomy

The taxonomy of *Isurus oxyrinchus* is:

Kingdom	*Animalia*
Phylum	*Chordata*
Subphylum	*Vertebrata*
Class	*Chondrichthyes*
Subclass	*Elasmobranchii*
Order	*Lamniformes*
Family	*Lamnidae*
Genus	*Isurus*
Species	*Isurus oxyrinchus*

(Integrated Taxonomic Information System webpage 2021). The shortfin mako is a member of the *Lamnidae* family of mackerel or white sharks, which is composed of three genera containing five living species, including the longfin mako shark (*Isurus paucus*), porbeagle shark (*Lamna nasus*), salmon shark (*Lamna ditropis*) and great white shark (*Carcharadon carcharias*).

C. Physical Characteristics

The shortfin mako shark has a slender, hydrodynamic body with pectoral fins that are broad, narrow-tipped and shorter than its head (Figure 1). The head is conical with a pointed snout and large eyes. The teeth in the front of the jaw are long, narrow and non-serrated with reflexed tips, while the teeth in the rear of the mouth are smaller and triangular. The first dorsal fin is broad and large, the second dorsal fin and anal fins are significantly smaller, and the caudal fin is crescent-shaped. The shortfin mako is dark blue in color on the dorsal side and white on its ventral side, under the snout and mouth region (Florida Museum webpage 2018 (citing Compagno et al. 2005)). From nose to tail, adult male shortfin mako sharks often reach over 2 meters while females can reach 3 meters or more (Mollet et al. 2000, at 303; Stevens 1983, at 126).

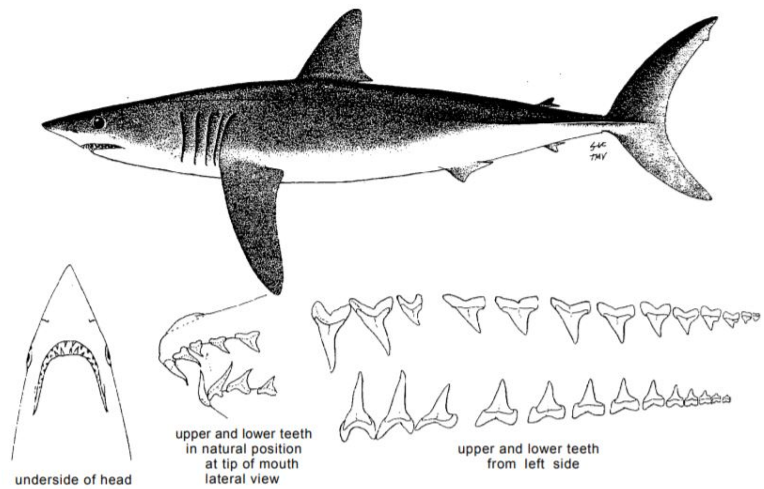

Figure 1. Sketches of the shortfin mako (Compagno 1984, at 243).

D. Habitat and Range

The shortfin mako is found in all temperate and tropical waters of all oceans (Figure 2). Globally, the shortfin mako utilizes a wide range of marine habitats. It inhabits open ocean, continental shelf, shelf edge, and shelf slope habitats during periods of transit (Rogers et al. 2015, at 205; Francis et al. 2019, at 12–14). It can be found both far offshore as well as close to shore. The shortfin mako has one of the highest metabolic rates relative to other active sharks (Sepulveda et al. 2007, at 1087), and is renowned as the fastest-swimming shark on record.

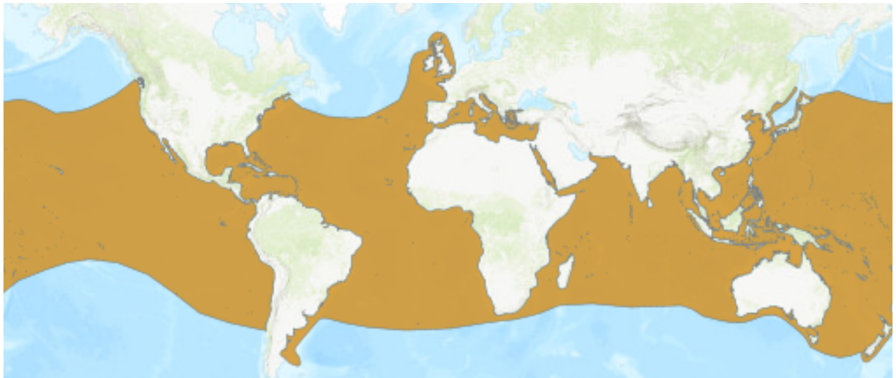

Figure 2. Global distribution of the shortfin mako (Rigby et al. 2019, at 3).

Shortfin mako sharks are generally regarded as highly migratory, yet recent research has shown them to regularly switch between states of activity. These sharks spend about half their time (44–47%) in a resident or fidelity behavioral state and slightly less than half their time (35–42%) in a traveling or transit state (Francis et al. 2019, at 5; Rogers et al. 2015, at 210). When traveling, the shortfin mako makes extensive long-distance movements (CMS 2008, at 2, 5). Studies conducted by NMFS and in New Zealand reported the maximum time at liberty (traveling at sea) of 8.2 and 6.5 years, and the maximum straight-line distance between tag and recapture localities as 2452 and 3000 nautical miles, respectively. Individuals also exhibit high fidelity to small geographic regions for extended periods (Corrigan et al. 2018, at 5).

Shortfin mako juveniles and immature individuals primarily reside along coastlines where waters are more productive, likely have a higher concentration of prey, and may be more sheltered from predators (Francis et al. 2019, at 5; Rogers et al. 2015, at 216). Tagging studies show that the coast of the Southern California Bight (Nasby-Lucas et al. 2019, at 1–26 (n = 105, 13-year study)), Great Australian Bight (Rogers et al. 2015), and Japan (Kai et al. 2017) serve as important habitat for young-of-the-year (<100 cm fork length) and juveniles (small males and females <165 cm fork length), in addition to larger sharks. The fact that coastlines such as these serve as shark nurseries may explain why the primary shortfin mako shark age group caught by fisheries is juveniles (Nasby-Lucas et al. 2019, at 2).

Shortfin mako sharks spend most (at least 75%) of their time in surface waters (above 20 m) (Abascal et al. 2011, at 1181; Holts & Bedford 1993, at 907; Sepulveda et al. 2004, at 198). Tagging studies (including data from NOAA's US-PRT-URY collaboration project (Santos et al. 2020, at 238) show that shortfin mako sharks spend most of their time (e.g., 82% of the time (Stevens et al. 2010, at 578)) in depths above 100 m (known depth range of 0–740 m) or even 50 m (Nasby-Lucas et al. 2019, at 5). The sharks typically rotate their vertical habitat use on a diurnal pattern, spending days in deeper, cooler water and nights in shallower, warmer waters (Abascal et al. 2011, at 1182; Loefer et al. 2005, at 237–46; Nasby-Lucas et al. 2019, at 5; Sepulveda et al. 2004, at 193; Stevens et al. 2010, at 580–81). Larger individuals tend to swim to greater maximum depths than smaller individuals (Sepulveda et al. 2004, at 196), and juveniles in particular tend to spend much of their time in shallower, warmer water (e.g., 82% of the time in 20–21°C off southern California (Holts & Bedford 1993, at 901–09)). Deep dives likely enable the sharks to access a greater abundance of food, as mesopelagic organisms—the preferred prey of the shortfin mako—are common inhabitants of the deep sea (Francis et al. 2019, at 12).

The shortfin mako's biochemistry influences its habitat preferences. With a metabolic rate higher than most other sharks, shortfin mako sharks generally avoid waters with low levels of dissolved oxygen (Sepulveda et al. 2007, at 191–99). Tracking studies show that shortfin mako sharks typically inhabit waters with dissolved oxygen concentrations greater than 3 mg/l (Abascal et al. 2011, 1175–84).

Shortfin mako sharks also prefer a range of water temperature from 17–31˚C (Abascal et al. 2011, at 1177; *see generally* Casey & Kohler 1992; Loefer et al. 2005; Nasby-Lucas et al. 2019; Santos et al. 2020; Stevens et al. 2010). Temperatures below or above this range create a thermal barrier to migration traceable via oceanic movement patterns and depth data. Although debate exists about whether the threshold is 17–22°C (Casey & Kohler 1992, at 58; Santos et al. 2020, at 235) or 22–31°C (Vaudo et al. 2017, at 1769, 1773), and it may well differ depending on how resources associated with temperature differ, studies consistently conclude that thermal barriers limit movement between regions. For example, shortfin mako sharks infrequently cross the Mid-Atlantic Ridge between the western and eastern North Atlantic Ocean (Casey & Kohler 1992, at 56; Santos et al. 2020, at 243–45), and infrequently cross the Gulf Stream between the western North Atlantic Ocean and Gulf of Mexico/Caribbean Sea (Byrne et al. 2017, 5–7; Vaudo et al. 2017, at 1771, 1773). See the regional subsections below for more evidence of movement constraints within regions.

Thermal equatorial fronts also appear to form a dispersal barrier limiting movement between northern and southern hemispheres, and between ocean regions. A review reported that only one tagged shark was known to have crossed the equator (Corrigan et al. 2018, at 12 (citing Holdsworth & Saul 2017; Rogers et al. 2015a; Rogers et al. 2015b; Sippel et al. 2011)). The ICCAT Shark Research and Data Collection Program telemetry study (2015–2019, n = 43) similarly found spatial segregation between the North and South Atlantic (Santos et al. 2020, 243–45). NMFS's Cooperative Shark Tagging Program ("CSTP") reported that 75% of tagged sharks (1962–2000, n = 608) traveled less than 500 nm from their original tagging location, and very few individuals were recaptured outside of the tagging region (Figure 3). Shortfin mako sharks in temperate regions of both hemispheres show fidelity to regions of high productivity (Vaudo et al. 2017, at 1771) and often hug coastlines around a single continent, which could help explain (in combination with the water temperature barriers) why global movement is constrained.

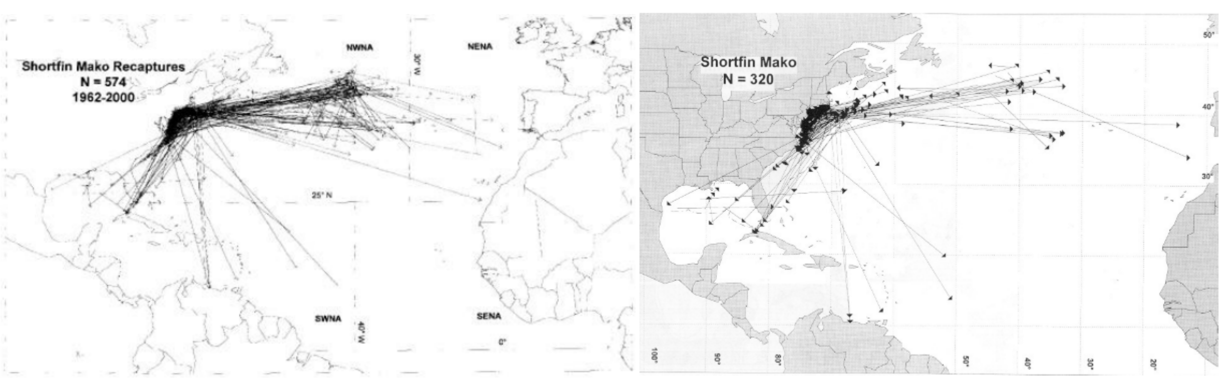

Figure 3. Shortfin mako sharks tagged by NMFS CSTP (left, n = 608) (Kohler et al. 2002, at 30), showing high fidelity in the west North Atlantic. This pattern can be seen more clearly from a prior study based on a smaller subsample of the same data (right, n = 320) (Campana et al. 2004, at 17).

Spatial restrictions shaped by water temperature barriers and other factors have an important signature in genetic analyses. Genetic studies report that shortfin mako sharks represent one global population with genetic substructuring between ocean basins (Corrigan et al. 2018, at 6; Schrey & Heist 2003, at 670–74). Put simply, the shortfin mako shark is a "globally panmictic population" in which "populations may be genetically homogenous across large geographical areas as a consequence of few reproductively active migrants, although spatial partitioning exists" (Corrigan et al. 2018, at 1). This spatial partitioning is especially obvious from tagging studies, which shows limited movement between ocean regions.

Studies using modern molecular analyses (genomics and nuclear genetics) consistently conclude that there is only weak evidence of genetic isolation between populations across the world. In other words, there appears to be sufficient cross-regional migration to maintain gene flow between regions. A microsatellite analysis of samples globally (n = 432, four microsatellite loci), covering the North/South Atlantic Ocean, North/South Pacific Ocean and Indian Ocean, found "very weak" evidence of population structure, and significant linkage disequilibrium in just one loci pair in a coastal South African sample (n = 26) (Schrey & Heist 2003, at 670–74). An analysis of nuclear DNA data from shortfin mako sharks in six regions in the southern hemisphere (n = 275) and two in the northern hemisphere (n = 114) reported a globally connected population (Corrigan et al. 2018, at 1, 6). Preliminary analysis of the first complete mitochondrial genome from the Atlantic Ocean compared to a Pacific-sourced shortfin mako specimen indicated similar rates of mitochondrial gene variation similar to samples from another lamnid shark species, indicating no evidence of population structure (separate populations) between the hemispheres (Gorman et al. 2019, 3642–43).

In contrast, studies using mitochondrial DNA, which evolves at faster rates given the smaller effective population size compared to nuclear DNA, report some structure between populations resulting from restrictions in gene flow. The clearest evidence of population substructure exists between the North Atlantic and all other oceans (Corrigan et al. 2018, at 10; Heist et al. 1996, at 586). Evidence is mixed for the other oceans, with some research supporting population substructuring between the North and South Pacific Ocean, Indian Ocean and South Atlantic Ocean, and other research not supporting such substructuring (see ocean region-specific sections below for details). This difference between mitochondrial and nuclear DNA suggests that the global movement of shortfin mako sharks may have become more restricted recently (although that timeframe is unclear). Nohara et al. propose that this difference may be a result of sex-dependent limited migration leading to a maternally biased mitochondrial DNA genetic structure, though they suggest that it may also be a result of inadequate analyses (Nohara et al. 2020, at 2). On the whole, the mitochondrial DNA research suggests that shortfin mako sharks in the North Atlantic is considerably isolated from other oceans, whereas shortfin mako sharks around the rest of the globe are largely separate but have some degree of genetic connectivity through movement, at least historically.

Given that ecological constraints such as water temperature restrict spatial movement with some effect on gene flow, here we overview differences in shortfin mako shark movement within and across the oceans of the world. Tagging data reveals clear separation in populations of shortfin mako sharks between the oceans and hemispheres of the world.

1. North Atlantic Ocean

The Mid-Atlantic Ridge creates a thermal barrier separating shortfin mako sharks in the North Atlantic into western and eastern populations (Figure 4). Casey and Kohler conducted a large-scale telemetry study (1962–1989, n = 231) and found that only one of the tagged shortfin mako sharks in the western North Atlantic was captured east of the ridge (Casey & Kohler 1992, 56). The study reported that the core distribution of shortfin mako sharks in the western North Atlantic exists between 20ºN and 40ºN, between the Gulf Stream and the Mid-Atlantic Ridge. The ICCAT Shark Research and Data Collection Program telemetry study (2015–2019, n = 43) similarly showed complete spatial segregation between shortfin mako sharks tagged along the western and eastern coast of the North Atlantic (Santos et al. 2020, at 235).

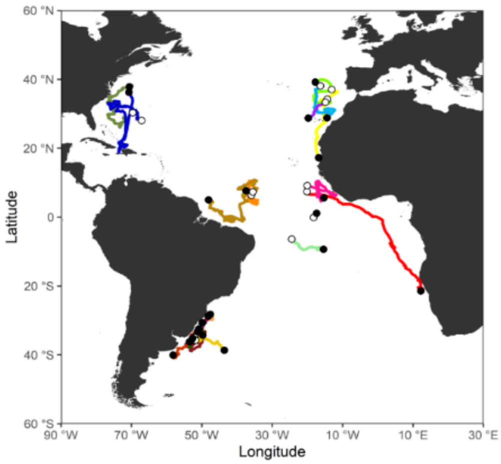

Figure 4. Maps showing spatial segregation of shortfin mako sharks between the west and east North Atlantic Ocean, as well as the northern and southern hemisphere (bottom left showing miniPAT tags, bottom right showing sPAT tags) (Santos et al. 2020, at 244, 245).

In the southwestern North Atlantic, the Gulf Stream separates the western North Atlantic and Gulf of Mexico/Caribbean Sea (Figure 5). Both Byrne et al. (2013–2016, n = 40) and Vaudo et al. (2013–2015, n = 26) reported little distributional overlap between shortfin mako sharks tagged in the western North Atlantic and the Gulf of Mexico/Caribbean Sea.

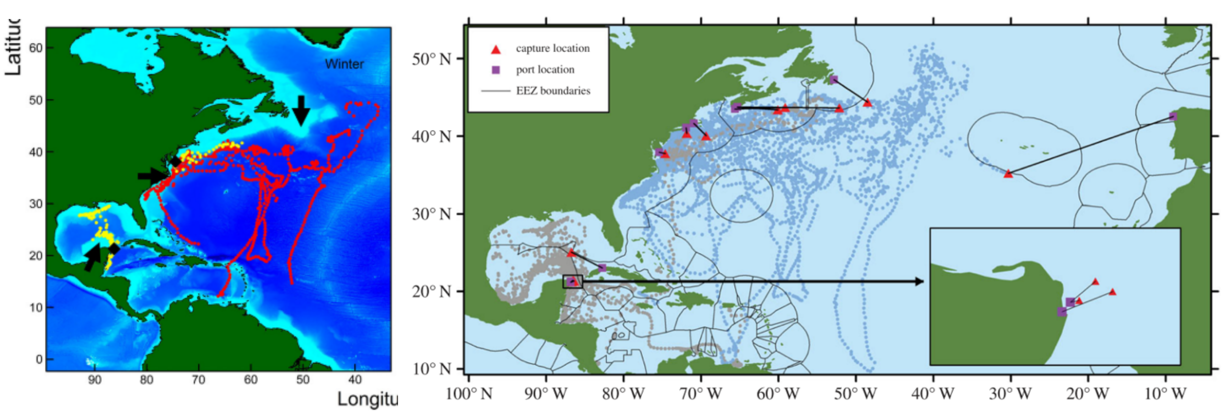

Figure 5. Maps showing spatial segregation between the west North Atlantic and Gulf of Mexico/Caribbean Sea (left) (Vaudo et al. 2017, at 1771), (right) (Byrne et al. 2017, at 5).

Genetics studies indicate some isolation between the North Atlantic and other regions. One mitochondrial analysis of 21–30 samples from each of five locations in the North/South Atlantic and North/South Pacific Oceans found a significant partitioning of haplotypes between the North Atlantic and other regions (Heist et al. 1996, at 586). Another mitochondrial analysis (n = 106) indicated genetic structuring between the North Atlantic and Pacific Ocean groups, with a break in the Indian Ocean (Taguchi et al. 2011, at 2). An analysis of shortfin mako sharks from six regions in the southern hemisphere (n = 275) and two in the northern hemisphere (n = 114) reported that mitochondrial DNA data show a substructure across hemispheres (Corrigan et al. 2018, at 1). A study of microsatellite DNA of shortfin mako sharks also detected population structure between the North Atlantic and North Pacific, although additional testing is needed (Schrey & Heist 2003, at 670–74). While these studies do not provide conclusive evidence of completely isolated populations, they do indicate restriction of gene flow between the North Atlantic and other regions, which supports the spatial restrictions reported by tagging and telemetry research.

Several genetic studies call for region-specific management implications given their results. Based on their findings from mitochondrial DNA, Heist et al. report that the genetic divergence between the North and South Atlantic Oceans suggest that "if the shortfin mako is overfished in the North Atlantic, replenishment will have to rely on intrinsic rather than migrational growth" (Heist et al. 1996, at 586). Similarly, Corrigan et al. emphasize that "[s]ignificant spatial partitioning may occur despite high genetic connectivity and the number of migrants per generation required to allow stock rebuilding may be much higher than is required to produce genetic homogeneity" (Corrigan et al. 2018, at 11–12).

2. South Atlantic Ocean

In the South Atlantic Ocean, the ICCAT Shark Research and Data Collection Program telemetry study (2015–2019, n = 43) showed spatial segregation between shortfin mako sharks tagged along the eastern coast of South America and the western coast of Africa (Figure 4; Santos et al. 2020, at 235–46).

Mitochondrial genetics research found evidence of genetic divergence between samples from the South Atlantic and the North Atlantic, but not between the South Atlantic and other oceans (Heist et al. 1996, at 585–87). A study using mitochondrial DNA reported no evidence of population structure between the South Atlantic and other oceans (Schrey & Heist 2003, at 670–74). These studies indicate that, although the North and South Atlantic appear to be spatially segregated, historically there has been sufficient exchange between the South Atlantic and other oceans to prevent the accumulation of detectable genetic divergence.

3. North Pacific Ocean

Research through the International Scientific Committee ("ISC") Shark Working Group based on NOAA's Southwest Fisheries Science Center and other tagging data contradicts the hypothesis of panmixia. Findings suggest shortfin mako stocks in the Pacific Ocean are separated at the minimum into northern and southern sub-populations demarcated by the equator (Figure 6; Sippel et al. 2016, at 3). The data also indicates separation between the western and eastern North Pacific. Most shortfin mako sharks tagged (n = 1,193; sampling has occurred since 1968) were recaptured in the

same region in which they were tagged. The hemispheric population structure suggested by tagging data is consistent with genetics data (Sippel et al. 2016, at 6 (citing Michaud et al. 2011)).

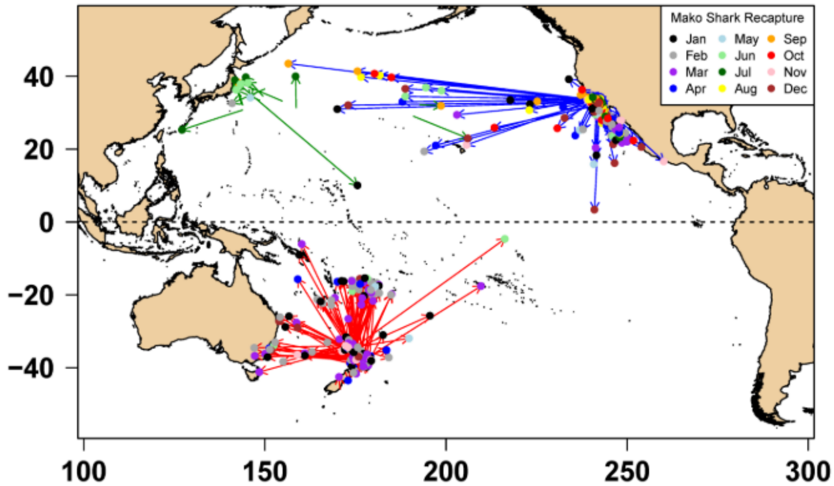

Figure 6. Recaptures of shortfin mako sharks tagged by NOAA and other programs in the Pacific, indicating separation between the northern and southern hemispheres (Sippel et al. 2016, at 3).

In the southeastern North Pacific, tagging research off the United States and Mexican coasts (n = 105, 13-year period) revealed that shortfin mako sharks did not extend into the South Pacific (Nasby-Lucas et al. 2019, at 1). These sharks make extensive offshore movements, predominantly in the winter and spring months (Figure 7). Shortfin mako sharks moved either directly offshore from the Southern California Bight or followed movement north or south within the California Current. Shortfin mako sharks also used areas near the North Equatorial Current, where fisheries data are not available. Individuals tended to return to the same general offshore destination in successive years.

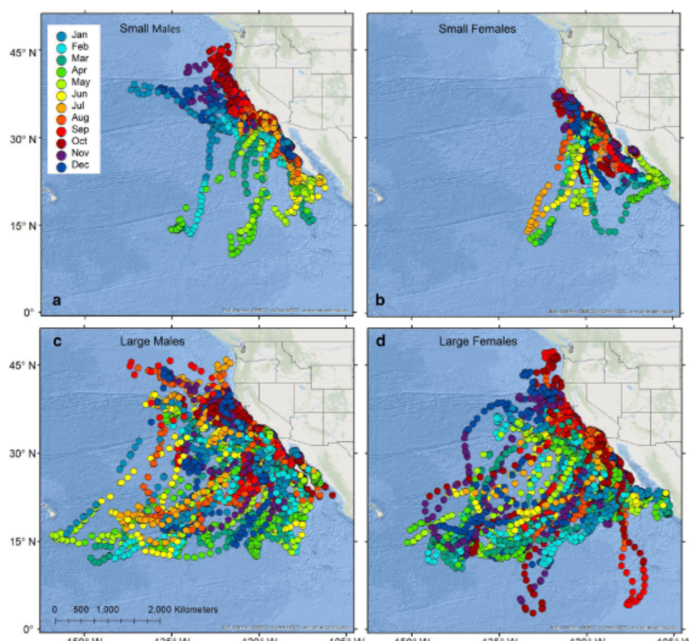

Figure 7. Shortfin mako shark movements in the eastern North Pacific off the coast of California and Mexico (n = 105) (Nasby-Lucas et al. 2019, at 6).

In the North Pacific, there is also strong evidence of regional substructure by sex and ontogenetic stage (Sippel et al. 2015, at 5 (citing Kai et al. 2015; Semba & Yokawa 2011)). A study of data based on U.S. fisheries and other data (n = 326) indicate that the proportion of females is higher (>50%) in the Northwest Pacific and lower (<50%) in the Central Pacific, although there is spatial variance within subregions (Figure 8 (citing Sippel et al. 2015)). Females and males are both larger-bodied in the Central Pacific. Female shortfin mako pups are found in the Northwest Pacific, north of Hawaii and near the Southern California Bight, and male pups are found in the Northwest Pacific and Southern California Bight (Figure 8 (citing Sippel et al. 2015)). The researchers propose a five-region stratification of the North Pacific shortfin mako population to account for differences in mean size by sex.

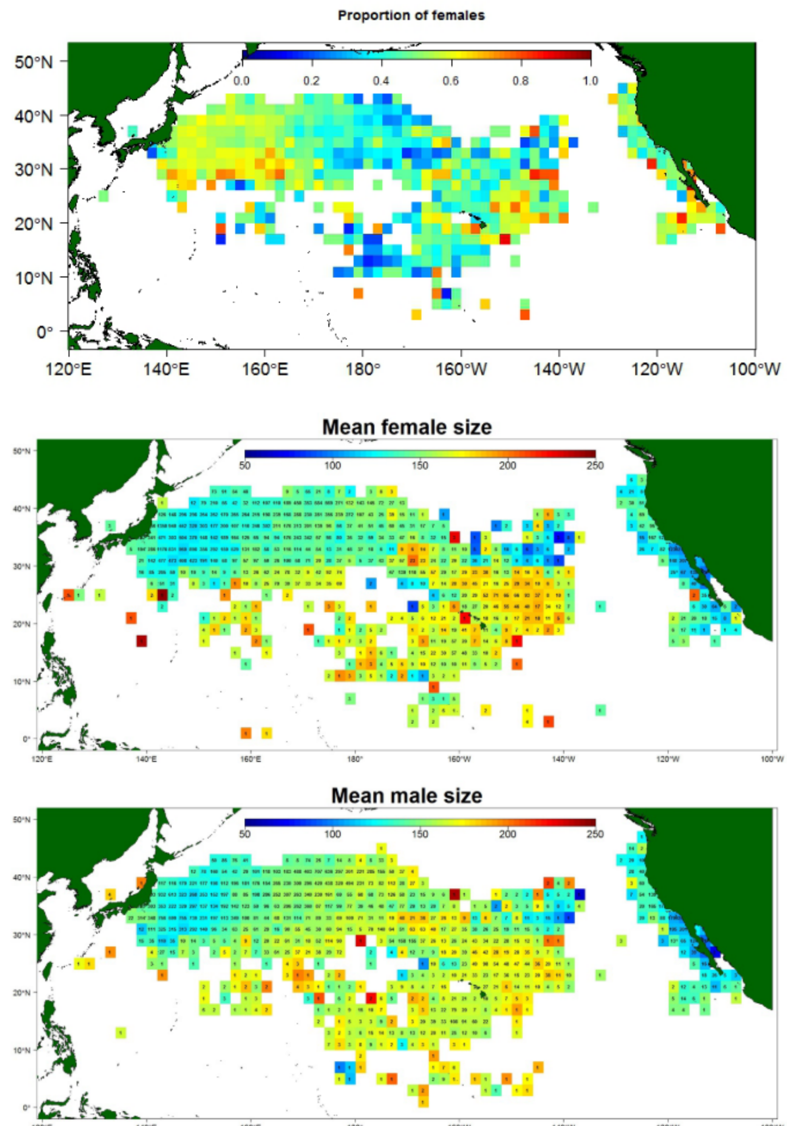

Figure 8. Spatial differences in the location of shortfin mako sharks in the North Pacific by sex (top) and size (middle, bottom) (n = 326) (Sippel et al. 2015, at 7–8).

Genetic work supports the separation of the Pacific Ocean shortfin mako population from other oceans shown by telemetry studies, although the genetic differentiation between North and South Pacific does not appear to be as distinct. A study using microsatellite DNA detected some population structure between the North Atlantic and North Pacific shortfin mako sharks, although results were considered weak (Schrey & Heist 2003, at 670–74). An analysis based on a larger number of microsatellite markers reported that shortfin mako lack differentiation across the Pacific Ocean (Taguchi et al. 2015). Another study using mitochondrial DNA for the ISC Shark Working Group found clear genetic differentiation between the Pacific Ocean and the North Atlantic and Indian Oceans (Taguchi et al. 2011, at 2). The same study did not report significant differentiation within the Pacific Ocean; however, genetic divergence was larger between the South and North Pacific than within the South Pacific, indicating some genetic divergence of sharks between the North and South Pacific Oceans.

4. South Pacific Ocean

In the southeastern Pacific, tagging off northern Chile showed that individuals (n = 9) remained within this region for 341 tracking days (Figure 9; Abascal et al. 2011, at 1177, 1181).

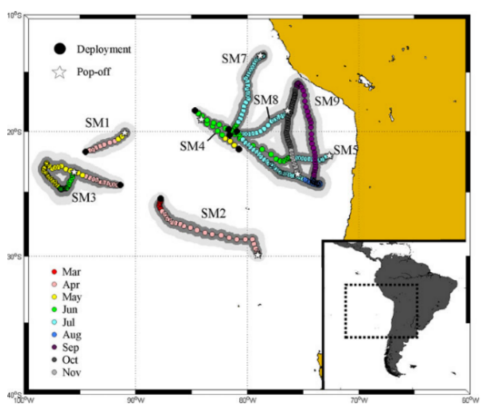

Figure 9. Tagging data (n = 9) showing shortfin mako shark movement off the coast of Chile (Abascal et al. 2011, at 1177).

In the Southwest Pacific, shortfin mako sharks spatially segregate around Australia. A study of 13 tagged individuals for 249–642 days (6 individuals tracked for more than 1 year) showed extensive movement around the coastlines of Australia, with long-range dispersal tracks in one or two directions each year (Figure 10; Corrigan et al. 2018, at 6). Off the eastern coast of Australia, one tagged shortfin mako remained in the region (Stevens et al. 2010, at 587).

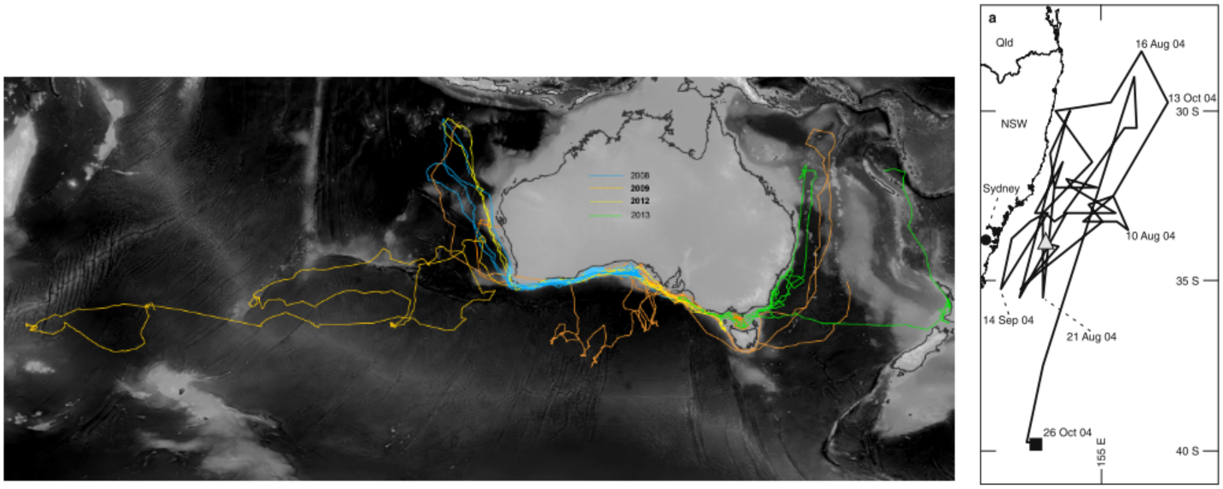

Figure 10. Movement tracks based on tagged individuals in southern Australia (left, n = 13) (Corrigan et al. 2018, at 6), and eastern Australia (right, n = 1) (Stevens et al. 2010, at 587).

For genetic evidence, see Section II.D.4. Habitat and Range, North Pacific Ocean.

5. Indian Ocean

Two studies on shortfin mako sharks tagged off the western coast of Australia report the sharks spending considerable time travelling throughout the continental shelf out to the slope off southern and western Australia, and considerable time travelling on the mid-outer shelf (Corrigan et al. 2018, at 12 (n = 13); Rogers et al. 2009, at 32 (n = 5)). Tagged sharks utilized the outer shelf and slope during migrations to and from the northeast Indian Ocean. While some individuals moved around the east coast of Australia (Corrigan et al. 2018, at 3–4, 6), the majority of tagged individuals between the two studies remained within the Southern and Indian Oceans, indicating separation from the other oceans of the world.

Genetic evidence is currently unclear as to how and whether the Indian Ocean population is connected or separated from other populations. A study of mitochondrial DNA did not find evidence of genetic divergence among the Indo-Pacific and South Atlantic Oceans (Heist et al. 1996, at 586). In contrast, another study using mitochondrial DNA found that the Indian Ocean served as a genetic break between the North Atlantic and Pacific Oceans (Taguchi et al. 2011, at 5). A more recent study using mitochondrial DNA found mixed results regarding the differentiation between Australasian and South African populations, with some tests suggesting low divergence and others suggesting significant differentiation between populations. The study concluded that there was high genetic connectivity within Australian waters (Corrigan et al. 2018, at 1).

E. Feeding

The shortfin mako shark is considered an apex predator throughout its range, occupying a top trophic level as a tertiary predator (Cortés 1999, at 707–17; Wood et al. 2009, at 76–87). The species is considered a generalist with a diverse diet (Meneses et al. 2016, at 18), the specific contents of which depend on the geographic location, depth, time of year, and oceanic habitat of individual shortfin mako sharks (Preti et al. 2012, at 127). Across its range, oceanic teleosts are the most common prey of shortfin mako sharks, with anchovies, bluefish, bonitos, cod, herring, sardines,

swordfish, and tuna among the most commonly consumed species (Compagno 1984, at 244; Preti et al. 2012, at 127; Wood et al. 2009, at 77). The shortfin mako shark also subsists on cephalopods, elasmobranchs, and marine mammals (Biton-Porsmoguer et al. 2015, at 177, 181; Groeneveld et al. 2014, at 1046; Preti et al. 2012, at 127). In addition to killing their own prey, shortfin mako sharks are known to scavenge, consuming parts of prey dead or alive (Biton-Porsmoguer et al. 2015, at 177).

With one of the highest routine and maximum metabolic rates among sharks (Sepulveda et al. 2007, at 191), shortfin mako sharks must consume, on average, nearly 4.5% of their bodyweight each day to meet their energetic demands (Wood et al. 2009, at 84). In regions where the shortfin mako coexists with other apex predators, evidence suggests that the species utilizes diet specialization and niche partitioning, such as by targeting larger pelagic teleosts and cephalopods than do its competitors when coexisting with common thresher sharks in Australia (Preti et al. 2012, at 127–44; Rogers et al. 2012, at 1389–90).

1. North Atlantic Ocean

In the Northwest Atlantic, teleosts make up 98% of the diet by volume, with bluefish constituting 78–93% of the shortfin mako shark's diet by volume (Stillwell & Kohler 1982, at 408; Wood et al. 2009, at 80). Bluefish is the major food item inshore (<91 m depth). It is worth noting that bluefish abundance in the Northwest Atlantic has fluctuated significantly over time, with total stock biomass declining 72% from 1982 to 1997 and then doubling by 2004 (NEFSC 2005, at 53–135). Interestingly, these changes in prey are not reflected in the diet of the shortfin mako and bluefish still represent a very high proportion of prey consumed (Wood et al. 2009, at 77). Given the significant decline in shortfin mako shark abundance over the same period—43% decline from 1986 to 2005 (Cortés et al. 2007, at 43)—it is likely that shortfin mako abundance in this region has declined alongside bluefish, such that the lower predator abundance follows the lower abundance of prey items (Wood et al. 2009, at 85). In the Northwest Atlantic, offshore (91 m depth), where bluefish are less abundant, cephalopoda composed 15% of stomach contents by frequency of occurrence (Stillwell & Kohler 1982, at 407). Both sexes showed the same rates of consumption and diet composition.

In the Northeast Atlantic, teleosts constituted 90% of the shortfin mako diet by weight (Maia et al. 2006, at 157). Teleosts of choice included Clupeiformes, garpike, and fast-moving species like swordfish and lancetfish. Garpike, a species that occupies the upper water column, was consumed mostly during spring, when it may have a seasonal abidance off the Portuguese coast (Maia et al. 2006, at 164). Note that in contrast to the Northwest Atlantic, bluefish were not a significant part of the diet, despite their presence in this region. Crustaceans and cephalopods were also relatively important in the shortfin mako shark's diet. Seasonality affects diet, with shortfin mako sharks taking species readily available at any given time of year.

2. South Atlantic Ocean

Based on shortfin mako sharks collected from the longline fleet of Brazil in 2007–2008, the most important food category was teleost fishes followed by cephalopod mollusks (Gorni et al. 2012, at 1935). As in the Northeast Atlantic compared to the Northwest Atlantic, shortfin mako sharks do not consume bluefish despite the presence of bluefish in this region (Wood et al. 2009, at 85).

Crustaceans and other items were of low importance in the shortfin mako diet (Gorni et al. 2012, at 1935).

3. North Pacific Ocean

Stomach contents and isotopic analysis suggest that off the west coast of Baja California Sur, Mexico, shortfin mako sharks prefer the whitesnout searobin, Humboldt squid, tuna crab, and the sharpear enope squid (Meneses et al. 2016, at 13–18 (citing Galindo-Rosado 2011; Hernández-Aguilar 2008)). Males and females differed in prey consumption in the San Lázaro area off the coast of Baja California Sur, and isotope analysis indicated that females prefer a more coastal distribution than males (Meneses et al. 2016, at 17–18). Females primarily consumed Humboldt squid whereas males consumed Humboldt squid, tuna crab, and whitesnout searobin. The most important prey species in this area, whitesnout searobin, is a teleost that prefers coastal waters and a depth between 1 and 30 m (Meneses et al. 2016, at 18 (citing Bussing 1995)), indicating the shortfin mako probably spends much of its time in that same shallower part of the water column.

4. South Pacific Ocean

Shortfin mako sharks sampled in 2005–2006 off the coast of Chile had 17 prey species in their diet (Lopez et al. 2009, at 439). The diet consists of teleost fishes (87%), predominantly bigeye cigarfish (*Cubiceps pauciradiatus*), and 12% cephalopods, primarily Humboldt squid. No differences were found between sexes, although seasonal differences did occur.

5. Indian Ocean

In southern Australia (Southern Ocean), teleosts and cephalopods are also the primary prey. Teleosts, primarily barracouta (snoek) (*Thyrsites atun*), compose 68% of the total index of relative importance ("IRI") (note that IRI is a relative index that accounts for prey occurrence, numerical abundance of prey, and abundance by weight in the diet) and pelagic cephalopods accounted for 29% IRI (Rogers et al. 2012, at 1385, 1388).

In the southwestern Indian Ocean, inshore (sampled by swimmer/bather protection exclusion nets), elasmobranchs appear to make up a much greater percentage of the shortfin mako's diet than other regions. By weight, 73% of shortfin mako stomach contents were elasmobranchs, with dusky sharks (*Carcharhinus obscurus*) as the most important species (Groeneveld et al. 2014, at 1055). Teleosts composed 27% of the shortfin mako's stomach contents by weight, with spotted grunter (*Pomadasys commersonnii*) and tunas (Scombridae) the most important species. IRI analysis shows both elasmobranchs and teleosts as having similar degrees of importance to the shortfin mako despite the disparity in contribution to percent weight of stomach contents.

However, offshore (sampled by longliners), elasmobranchs were essentially absent from diet samples (Groeneveld et al. 2014, at 1054). Here, teleosts were the primary food, composing 84% of sampled stomachs with food; cape horse mackerel (*Trachurus capensis*) and sardine (*Sardinops sagax*) were the most prevalent species. Cephalopods made up around 14% of the shortfin mako's diet.

F. Reproduction and Lifespan

Shortfin mako sharks have a 3-year reproductive cycle that includes an 18-month resting period after parturition (Mollet et al. 2000, at 308, 314). Their gestation duration is longer than in other lamnid sharks and apparently varies by region, usually ranging from 18–24 months (Duffy & Francis 2001, at 323; Joung & Hsu 2005, at 488; Mollet et al. 2000, at 315). Parturition likely occurs over several months in winter and spring (Bustamante & Bennett 2013, at 180; Mollet et al. 2000, at 309), although multiple studies suggest that the parturition period extends into the summer (especially around Australia and New Zealand) and potentially occurs year-round (Duffy & Francis 2001, at 323; Joung & Hsu 2005, at 494; Semba et al. 2011, at 27; Stevens 1983, at 126–30 (Australia)).

As with other lamniform sharks, the shortfin mako is viviparous and exhibits embryonic oophagy (Snelson et al. 2008, at 26). Embryos hatch within the mother and continue to grow, receiving nourishment from unfertilized yolk ova until birth. Embryonic cannibalism is known to occur, although it is uncommon (Joung & Hsu 2005, at 493–95). Shortfin mako litter sizes range from 4 to 20 pups, and the average litter size is around 12 pups (Joung & Hsu 2005, at 494–95; Mollet et al. 2000, at 312; Stevens 1983, at 126). Litter size typically increases with maternal size (Mollet et al. 2000, at 312). Pups measure approximately 70 cm total length at birth. The shortfin mako's relatively late age of maturity, moderate longevity, and low annual fecundity mean that the species' productivity is low (Bishop et al. 2006, at 153; Mollet et al. 2000, at 299–315).

The maximum age of the shortfin mako is at least 29 years, however true longevity is likely higher than reported since the oldest individuals are often difficult to capture and in low abundance (Bishop et al. 2006, at 153). Age at maturity differs markedly between males and females but does not appear to vary by geographic location; males mature by 7 years while females reach maturity by 18+ years (Bishop et al. 2006, at 153; Natanson et al. 2006, at 367). Regional differences in median total length-at maturity and mass-length relationship exist, but in general shortfin mako males are 2 m in total length and females are closer to 3 m at maturity (Cliff et al. 1990, at 119–20; Francis & Duffy 2005, at 319; Joung & Hsu 2005, at 490; Mollet et al. 2000, at 303; Pratt & Casey 1983, at 1944–55; Stevens 1983, at 126).

G. Population Trends

No data are available on the absolute global population size of the shortfin mako shark. A comprehensive analysis of trend data for all populations was recently conducted by the IUCN in November 2018 (Rigby et al. 2019). We report these findings here accompanied by additional studies beyond the IUCN assessment.

The IUCN assessment estimated that the shortfin mako is declining globally in all populations except one (Rigby et al. 2019, at 5). Consequently, the IUCN assigned the species a status of "endangered" on the IUCN Red List. The IUCN assessment reported steep population declines in the North and South Atlantic, with declines also evident, though not as steep, in the North Pacific and Indian Oceans. The South Pacific is the only population that appears to be increasing, but nonetheless shows fluctuating catch rates. The IUCN estimated the global population trend (weighted according to the relative size of each region) to have experienced a median reduction of 46.6% with the highest probability of a reduction of 50–79% over three generation lengths (72–75 years).

In a proposal to list the shortfin mako under CITES in 2019, the population trend of the species' regional populations was also assessed (Table 1; CoP18 Prop. 42 2019, at 7).

Region	North Atlantic **(1)**	South Atlantic **(2)**	Mediterranean **(3)**	Indian Ocean **(4)**	South Pacific **(5)**	North Pacific **(6)**
% of the total distribution of the species **(7)**	14.50%	12.00%	1.10%	17.90%	22.00%	32.50%
Historical decline first 10 years with data vs. last 10 years	39%	Not available	>96%	26%	Not available	16.4%
Recent decline (0 to 10 years back)	32% (annual rate 4.2%)	Not available	Not available	18.8% (annual rate 2.1%)	2009-2013, no % estimated	Increase of 1.8% (annual rate of increase of 0.18%)
Projected decline (next 10 years)	60%	Not available	Not available	41.6%	Not available	Not applicable
Results of stock assessments **(8)**	Overfished and overexploited (90% prob.)	Overfished and overexploited (19% prob.)	Decline	Overfished but not overexploited	Not available	Neither overfished nor overexploited (>50% prob.)

Notes: 1= Estimated based on Table 7 of the publication by the ICAAT SCRS (2017); 2= Based on information provided by the ICCAT SCRS (2017); 3= Based on Ferretti (et al., 2008); 4= Estimated based on Figure 6B of Brunel et al. (2018); 5= Based on Rice (et al., 2015) and Clarke (et al., 2013a); 6 = Estimated based on Table 7 of the publication by the ISC-SWG (2018); 7= Based on the potential area of distribution of the shortfin mako, estimated by Cailliet et al. (2009), the authors of the present proposal calculated the area represented by each of the regions assessed in order to obtain a parameter to quantify their coverage; 8= Probabilities are only indicated when they are provided by the results of the models (i.e., results of an assessment with Bayesian, Stock Synthesis or similar models).

Table 1. CITES assessment of the shortfin mako in the regions where it occurs. Increases are shown in green; inconclusive data and declines between 1–40% are shown in yellow; declines greater than 40% are shown in red (CoP18 Prop. 42 2019, at 7).

1. North Atlantic Ocean

The primary source of population trend data for the North Atlantic population is the ICCAT stock assessments (Rigby et al. 2019, at 5). The IUCN trend analysis of the North Atlantic shortfin mako modeling biomass for 1950–2017 (68 years) revealed annual rates of decline of 1.2%, with a median decline of 60.0% over three generations (75 years) (Rigby et al. 2019, at 4). This indicates the highest IUCN probability level of reduction (50–79%) over three generation lengths.

These rates of decline are corroborated by the recent 2019 ICCAT stock assessment for the North Atlantic shortfin mako (ICCAT 2019a). This assessment shows substantial population declines and recommended a strict reduction in total allowable catch ("TAC"). Stock Synthesis projections show there is a long lag time between when management measures are implemented and when stock size starts to rebuild, due to the species' maturation delays and low fecundity. The ICCAT potential harvest rates show low probabilities (40–60%) of stock rebuilding over long timeframes (by 2070). ICCAT projected that regardless of the TAC—even if it is zero—the stock will continue to decline until 2035 before any biomass increases can occur (ICCAT 2019b, at 18; *see* Figure 11; Section IV.B.1. Overutilization for Commercial Purposes (discussing projections of stock management)).

Critically, the 2017 and 2019 and ICCAT stock assessments are considered more accurate and rigorous than the prior 2012 assessment, which suggested a low probability of overfishing, because they include more accurate parameters in the stock assessment models (ICCAT 2019a, at 8).

Other information corroborates the ICCAT and IUCN assessment findings. An analysis of historic data from U.S. pelagic longline logbooks and the U.S. pelagic longline observer program from 1986–2005 reported a 43% decline in the Northwest Atlantic Ocean for the shortfin mako shark (Cortés et al. 2007, at 43; *see* Figure 12). The shortfin mako shark has also faced steep declines in the Mediterranean Sea. Based on time series of abundance indices from commercial and recreational fishery landings, scientific surveys and sighting records, trends for the shortfin mako and porbeagle (*Lamna nasus*) combined showed an average instantaneous rate of decline in abundance of –0.12 (135 years) and biomass of –0.15 (106 years) (Ferretti et al. 2008, at 958). This equates to an estimated decline of 99.9% in abundance and biomass since the early 19th century.

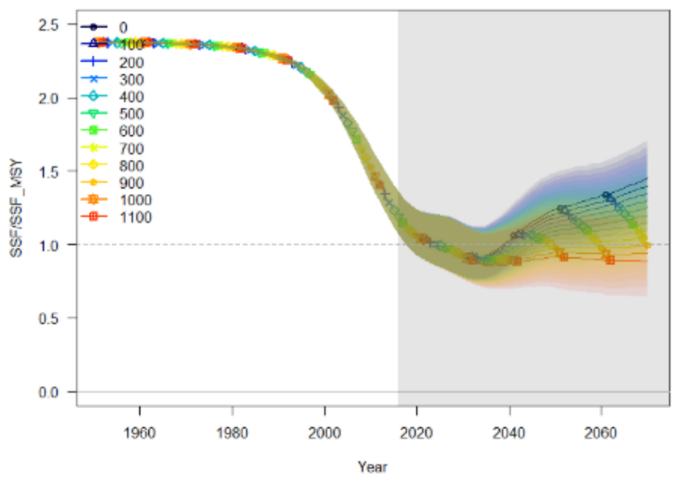

Figure 11. The most optimistic of three projection runs of the Stock Synthesis model, showing the ratio of spawning stock fecundity to fecundity at maximum sustainable yield (MSY) under different TAC (total allowable catch) scenarios (colors) (Courtney & Rice 2020, at 91–93). Note the large decline in reproduction rate (y-axis) since the 1980s due to the declining population.

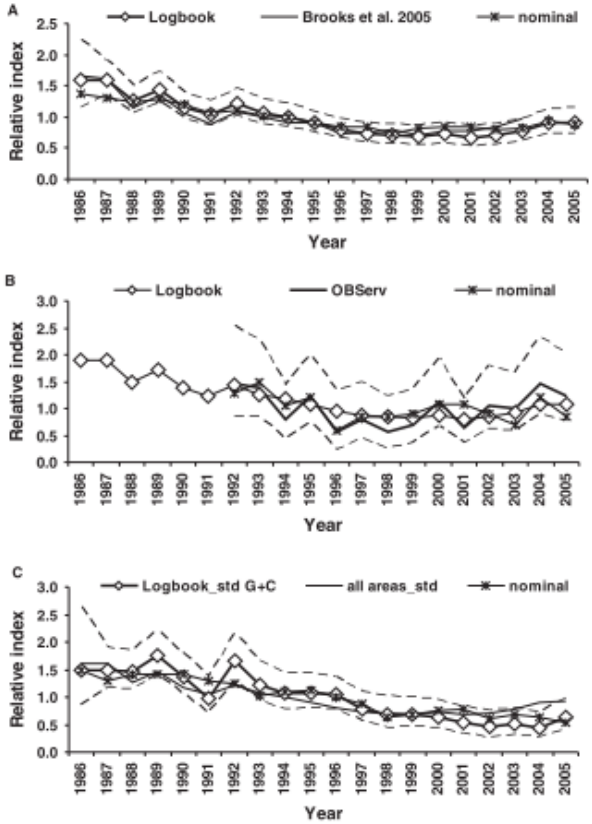

Figure 12. Nominal and standardized catch per unit effort number with 95% confidence intervals (dashed lines) for mako sharks (shortfin and longfin) from: (A) the pelagic longline logbook compared to a previous study by Brooks et al. 2005; (B) the pelagic longline observer program; and (C) the pelagic longline logbook restricted to areas 1 and 2 (Gulf of Mexico and Caribbean Sea) (Cortés et al. 2007, at 44).

2. South Atlantic Ocean

The primary sources of population trend data for the South Atlantic shortfin mako population are the ICCAT stock assessments (Rigby et al. 2019, at 4). The South Atlantic stock assessment biomass estimates were determined to be unreliable by the stock assessors, although they inferred that fishing mortality is likely unsustainable (ICCAT 2017a, at 5, 8). These findings were corroborated by an analysis of standardized catch rates of shortfin mako sharks on longlines in the South Atlantic, which showed steep declines of 99% in the average CPUE of 1979–1997 and 1998–2007 (Rigby et al. 2019, at 4 (citing Barreto et al. 2016)). Due to the lack of reliable data, the IUCN considered trends in the North Atlantic stock assessment to be representative of the South Atlantic. By extension, therefore, the IUCN modeled biomass for 1950–2017 (68 years) revealed annual rates of decline of 1.2%, with a median decline of 60.0% over three generations (75 years), and the highest probability level of reduction (50–79%) over three generation lengths (Rigby et al. 2019, at 4).

3. North Pacific Ocean

The North Pacific shortfin mako stock has been assessed both through region-specific studies, as well as by two broader assessments by ISC and the IUCN across the entire region. Collectively,

these report declines overall with mixed trends (stability and declines) in some regions and over some timeframes.

For the Northwest Pacific stock, a population analysis based on data from the Taiwanese longline fleet (1990–2004) indicated a declining trend from 1990–2000 and recommended reducing the fishing effort by 32% (Chang & Liu 2009, at 100). For the same fishery, another study used part of the same and updated data (1995–2005) to determine that the stock was declining (Tsai et al. 2011, at 3). This was further supported by a stage-based matrix demographic analysis (Tsai et al. 2014, at 1604–15). In the Northwest and Central Pacific during 2006–2014, a study based on Japanese fishery catch rates used a model to report an increasing trend from 2008–2014 (Kai et al. 2017, at 1765). In the Central and Northeast Pacific, a study based on longline fleet catch data used models to report a 7% annual rate of decline or 69% total decline from 1996–2009 (Clarke et al. 2013, at 1). Across the North Pacific, a study reported relatively stable CPUE trends from 2000–2010 but missing data prevented them from examining trends over 2006–2010 (Rice et al. 2015, at 5).

The ISC Shark Working Group assessed the shortfin mako stock across the North Pacific based on standardized catch data from the United States, Japan, Taiwan, and Mexico from 1975–2016. A base model and six scenario models were created and indicated a 50% probability that the stock is not experiencing overfishing or overexploitation (ISC-SWG 2018a, at 44). It estimated the impact of current fisheries at 0.16 whereas the expected impact at MSY is 0.26. Based on the number of females predicted by the model, the working group estimated a historical decline of 16.4% (1,024,000 individuals on average during 1975–1985 compared to 885,700 on average from 2006–2016), a recent increase of 1.8% with an annual rate of increase of 0.18% (844,800 individuals in 2006 and 860,200 individuals in 2016).

The IUCN assessment primarily relied on the ISC stock assessments (Rigby et al. 2019, at 4 (citing ISC-SWG 2018b)). The IUCN trend analysis of the modelled spawning abundance for 1975–2016 (42 years) indicated annual rates of decline of 0.6%, consistent with a median decline of 36.5% over three generation lengths (72 years), with the highest probability of 30–49% reduction over three generation lengths. This result differs from the published conclusion of the stock assessment, which reported the stock was likely not overfished and that overfishing was likely not occurring, because the longer timeframe of the IUCN analysis (72 years) revealed a greater decline than the shorter-term stock assessment (42 years).

4. South Pacific Ocean

The primary source of population trend data around Australia and New Zealand is the New Zealand longline observer standardized catch-per-unit-effort assessments (Rigby et al. 2019, at 4 (citing Francis et al. 2014)). The trend analysis indicated annual rates of increase of 0.5%, consistent with a median increase of 35.2% over three generation lengths (72 years), with the highest probability of increasing population over three generation lengths.

5. Indian Ocean

Studies and broad assessments are consistent in indicating declines across the Indian Ocean, as well as the indication that the shortfin mako is subject to overfishing but is not yet overfished.

A study of longline fisheries of the Soviet tuna industry from 1964–1988 in the western equatorial Indian Ocean found that shark catches represented 12.4% of total catches, that the shortfin mako was the second-most frequently-caught shark species—representing 1.99% of total catches, and that the shortfin mako was included in a major decline in CPUE indices and mean weight (Romanov et al. 2008, at 11). A regional assessment of elasmobranchs in the Arabian Sea and adjacent waters classified the shortfin mako as "near threatened" in the area, from CPUE data that suggested variable abundance but not a significant population decline (Jabado et al. 2017, at 103). However, they noted a decreasing average size of individuals in countries such as Oman. Given the intense pelagic fisheries in the region, and high susceptibility of the species, the assessment estimated that the shortfin mako had experienced population declines of 20–30% in the last three generations (75 years) (Jabado et al. 2017, at 103). A preliminary stock assessment using catch rates of the longline fleet of European Union countries from 1971–2015 revealed that the shortfin mako is subject to overfishing in the Indian Ocean (fishing mortality is currently 2.57 times greater than the Fmsy value) but is not yet overfished (Brunel et al. 2018, at 12). This study estimates a historical decline of 26%, a recent (2005–2015) decline of 18.8% with an annual rate of decline of 2.1% and a projected 10-year decline of 41.6% from the historic baseline (comparing 1970–1980 to 2015–2025) (Brunel et al. 2018, at 9–15).

The IUCN Indian Ocean preliminary stock assessment indicated that the shortfin mako shark is not currently overfished but that the biomass trajectories trend towards an overfishing status (Brunel et al. 2018, at 2). The trend analysis of the biomass for 1971–2015 (45 years) showed annual rates of decline of 0.9%, consistent with the mean decline of 47.9% over three generation lengths (72 years), with the highest probability of 30–49% reduction over three generation lengths.

IV. THREATS

As demonstrated below, substantial scientific and commercial information indicates that listing the shortfin mako as endangered or threatened in all or in any significant portion of its range may be warranted. *See* 16 U.S.C. § 1533(b)(1)(3)(A). The species is declining on a global scale and faces threats including overfishing, pollution, habitat degradation, climate change, and more. Existing regulatory mechanisms have proven inadequate to protect the shortfin mako. Without adequate protections, the species' limiting life history characteristics, in combination with the other threats discussed, cause the shortfin mako shark to be in danger of extinction throughout all or a significant portion of its range or likely to become so within the foreseeable future throughout all or a significant portion of its range.

A. Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range

Shortfin mako sharks are already being seriously affected by pollutants in their environment that bioaccumulate and biomagnify to tremendously high levels in their bodies. These bioaccumulation and biomagnification issues are due to the species' high trophic position, long life, and large size. Relative even to other shark species, the shortfin mako shows considerably higher pollutant accumulation levels; one study reported the mean total contaminant level of shortfin mako sharks to be 15 times greater than that of the common thresher and 90 times greater than that of blue sharks (Lyons et al. 2019a, at 3). These high pollutant loads cause a variety of negative physiological impacts in the shortfin mako. Because the pollution of the oceans is ongoing, this represents both a current and future threat to the shortfin mako's habitat. Metabolic elimination of DDT and PCBs in teleosts

(shortfin mako prey) is limited and is assumed to be negligible for at least PCB congeners in shortfin mako sharks (Lyons et al. 2019b, at 6998). Furthermore, the impacts of these pollutants are often synergistic and will therefore have a compounded effect in excess of what their additive effects would be. Pollutants affecting sharks include organic pollutants or heavy metals such as polychlorinated biphenyls ("PCBs"), pesticides like dichlorodiphenyltrichloroethane ("DDT"), heavy metals like mercury and chemicals like arsenic; these are specifically addressed in this Petition. However, NMFS should consider all pollutants in the shortfin mako's habitat and their impact on the species during a status review.

1. Polychlorinated Biphenyls

The worldwide contamination of the oceans by PCBs is of great concern due to their toxic effects on humans and wildlife. PCBs constitute a class of 209 compounds with differential biological activity and toxicity (Storelli et al. 2003, at 1035). PCBs accumulate in the fat of sharks, are present in sharks throughout the world, and "certain, high trophic level sharks[, like the shortfin mako,] are likely to accumulate PCBs at potentially hazardous concentrations" (Gelsleichter & Walker 2010, at 499). PCBs produce neurotoxic and endocrine-disrupting effects and can have serious impacts on animals that ingest them (Storelli et al. 2003, at 1035). In other non-shark marine animals, PCBs have also been cited as the likely cause of a variety of additional pathological changes, including pneumonia, liver fibrosis, arthrosis, abscesses in muscles, lungs and other organs, skin lesions, reduced fertility, and heavy attacks from parasites. PCBs are extremely persistent, and to this day extensively contaminate aquatic sediments, forming "legacy" reservoirs of PCBs (Gelsleichter & Walker 2010, at 499). There is further deposition from the redistribution of PCBs from terrestrial stores and developing countries have not universally banned their production and use (Gelsleichter & Walker 2010, at 491–93). For highly mobile species like the shortfin mako, this means the sharks bioaccumulate contaminants as they migrate between regions, even if they reside at times within the jurisdiction of countries that have banned the release of PCBs.

Two different studies have documented PCBs in high concentrations within shortfin mako sharks, notably at higher levels than in other sampled shark species. One study of shortfin mako sharks sampled from NOAA shark survey cruises and fishing tournaments between 1996–2012 in the Southern California Bight of the North Pacific Ocean (n=31) found that shortfin mako young-of-the-year contained a mean level of PCBs of 17.8 ± 12 ug/g (Lyons et al. 2013, at 30–31; Figure 13). This level was higher than salmon and thresher sharks and comparable to white sharks. A second project by the same author (published as two papers) sampled shortfin mako sharks from sources including the Southwest Fisheries Science Center and the NMFS Service West Coast Region Fishery Observer Program in the Southern California Bight area from 2011–2013 (n = 4) (Lyons et al. 2019a; Lyons et al. 2019b). This study reported similar levels of PCBs between shortfin mako, common thresher and blue sharks, but found that shortfin mako sharks showed the most variability in PCB contribution (33 ± 12.6%), the most PCB congeners detected in one or more samples (91% of 54 congeners measured) and consistently higher detection frequencies of congeners across samples (71 ± 30% of samples) (Lyons et al. 2019a, at 4).

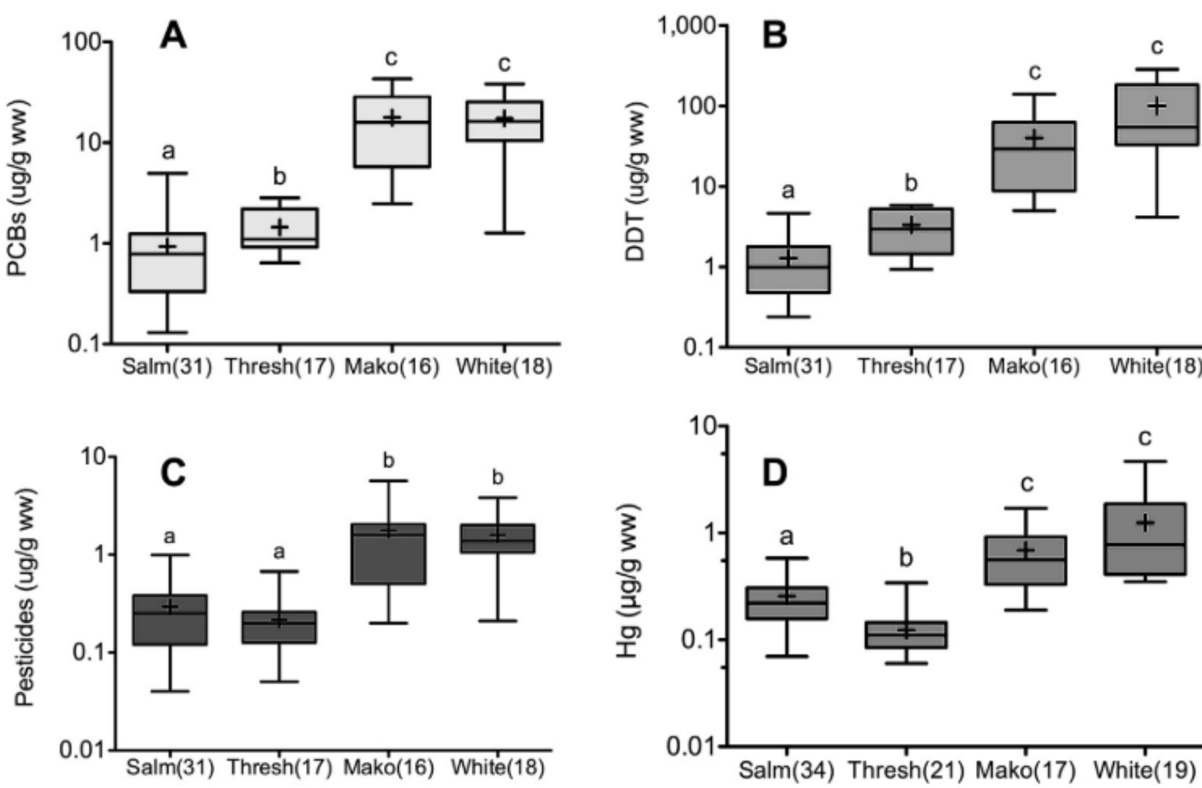

Figure 13. Contaminant concentrations of liver and muscle tissue among four species of young of the year sharks, including shortfin mako sharks, which were found to have significantly higher levels of all contaminants compared to thresher and salmon sharks (Lyons et al. 2013, at 31).

The same study (Lyons et al. 2019b) detected a parabolic relationship between PCB concentration and shortfin mako shark size/age, revealing insight into how closely pollutant accumulation is linked to ecology and reproduction. In shortfin mako sharks, the proportion of PCBs was similar between adults and young-of-the-year (Figure 14 (left)), likely the result of newborns reflecting their mother's signature of the contaminant due to material offloading (see paragraph below). As these young grew to ~150 cm FL their concentration of PCBs decreased, indicating growth dilution, meaning that the contaminant concentration remained the same while their body size increased, and suggesting that sources of high PCB input (e.g., prey items with large PCB signals) were low in the diet during this growth time. This is likely because juveniles tend to reside offshore, where PCB concentration is lower, than adult shortfin mako sharks, which reside nearshore where the PCB concentration is higher. Millions of pounds of PCBs were released into the Southern California Bight from the 1940s to the early 1970s before release was banned, and so it is likely that older shortfin mako sharks are accumulating these higher concentrations of contaminants while foraging nearshore. Indeed, at sizes greater than ~150 cm FL, where the growth of individuals stabilizes, a rise in PCB proportion occurred (*see* Figure 14 (left)), suggesting that PCB-heavy prey items are included in the diet.

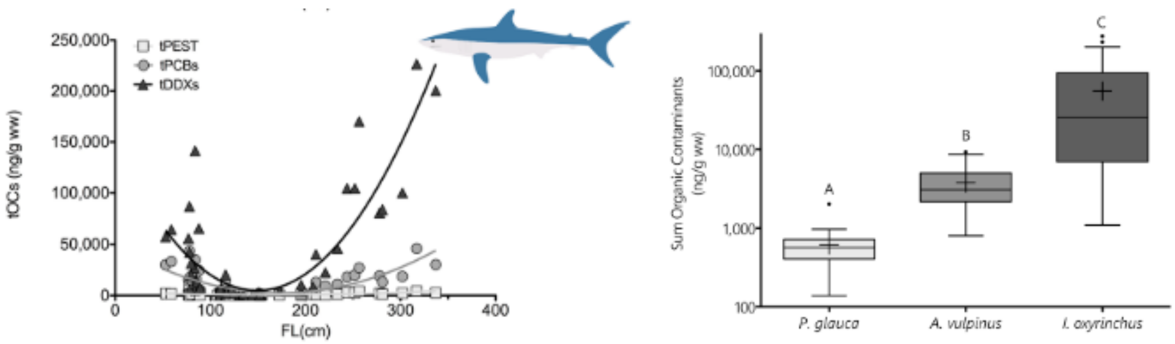

Figure 14. Concentrations of three main contaminant groups in shortfin mako shark livers sampled in Southern California Bight area between 2011–2013 (n=46). Mako sharks showed a parabolic relationship with contaminants by size, with the smaller and older sharks showing higher levels of contaminants and mid-sized sharks showing lower levels due to growth dilution (left) (Lyons et al. 2019b, at 7000). Mako shark contaminant levels considerably higher than other sharks, with mean total contaminant levels 15 times greater than common thresher and 90 times greater than blue sharks (right) (Lyons et al. 2019a, at 3).

Studies show that maternal offloading, or the transfer of accumulated contaminants from females to their young, occurs in shortfin mako (Lyons et al. 2019b, at 7002–03). This means that biocontaminants accumulated by older sharks during foraging and time spent in more polluted nearshore habitats are transferred from females to their young. Despite the fact that young-of-the-year mako typically reside in less polluted offshore habitats, they show bioaccumulation levels of PCBs, DDT, and other pesticides comparable to adult females (Lyons et al. 2019b, at 6998–7004). This is a significant finding that could affect the survivorship of juvenile mako and the recovery rate of the species:

> Initial contaminant concentrations in the smallest free-swimming individuals of [shortfin mako] are likely the result of maternal offloading, which not only represent a significant source of contaminant input for young sharks but also determine the "starting point" for species contaminant trajectories as they grow. Females passively transfer contaminants to offspring during reproductive activities, first through contaminants in yolk that embryonic sharks rely on early in gestation for nutrients and subsequently through additional matrotrophic investments throughout gestation . . . factors influencing the rate or potential ability of mothers to accumulate contaminants is then likely linked with the extent to which she can maternally offload.

(Lyons et al. 2019b, at 7002).

2. Mercury

In addition to PCBs, research indicates that shortfin mako shark also contain alarmingly high accumulations of mercury that exceed the legislated limit of many countries. Mercury has negative behavioral, neurochemical, hormonal, and reproductive impacts on fish, including emaciation, cerebral lesions and impaired gonadal development (Scheuhammer et al. 2007, at 13–14). A study of shortfin mako sampled from NOAA shark survey cruises and fishing tournaments between 1996–2012 in the Southern California Bight of the North Pacific Ocean (n=31) found that mako young-of-the-year contained a mean level of mercury of 0.68 ± 0.43 μg/g (Lyons et al. 2013, at 30; Figure

13). This level was higher than salmon and thresher sharks and comparable to white sharks. Nineteen percent (19%) of mako shark samples exceeded EPA levels of consumption concern (>1.3 μg/g ww), with maximum mercury concentrations of 1.7 μg/g ww. A different study reported one individual of shortfin mako sampled from the mid North Atlantic Ocean that presented a mercury content of 1.53 mg/kg wet weight, which is similarly above the legislated regulatory limit ML of 1 mg/kg wet weight set by the European Union (Torres et al. 2017, at 203, 205). Furthermore, while selenium content may provide protective benefits to fish, shortfin makos have unusually low selenium to mercury ratios, which may leave them especially vulnerable to the toxic effects of mercury as compared to other sharks and pelagic fish (Burger & Gochfeld 2012, at 12–23; Kaneko & Ralston 2007, at 242, 246–51).

Recent laboratory animal studies suggest that mercury neurotoxicity can be exacerbated by the presence of any PCBs (Storelli et al. 2003, at 1035). Therefore, because both PCBs and mercury appear to be present in shortfin mako in large amounts, the neurological threats to the species are greater than the risks posed by each toxin separately (Storelli et al. 2003, at 1035). Given that mercury concentrations in the ocean have increased by more than 30% in the last 20 years, and are estimated to double from 1995 mercury levels in the Pacific Ocean by 2050 under current mercury emission rates (Sunderland et al. 2009, at 1, 12), impacts from mercury pose a substantial current and increasing threat to shortfin mako.

3. Pesticides

Pesticides like DDT are a third substantial contaminant in habitat that threatens shortfin mako. Organochlorine pesticides ("OCPs"), which include DDT and its derivates, are neuroactive agents that affect ion permeability or act as agents for nerve receptors (Blus 2003, at 313–340). Although DDT has been identified in multiple shark species (e.g., Greenland sharks (*Somniosus microcephalus*) (Fisk et al. 2002, at 2165–70); Mediterranean sharks (*Centrophorus granulosus* and *Squalus blainvillei*) (Storelli & Marcotrigiano 2003, at 559–64)), little is known about how OCPs impact shark physiology and survivorship. OCPs are known to impact reproduction in fish (e.g., lake trout) and generally cause abnormalities in gonadal morphology and concentrations of sex steroids and create adverse effects on thyroid secretion, adrenal function, migratory condition, biogenic amines, the immune system, and many other physiological responses (Blus 2003, at 313–340). Accumulation levels for pesticides follow PCBs and mercury in reaching alarmingly high levels in shortfin mako, and higher levels than in other sharks (Lyons et al. 2013, at 27), reported that levels of both DDT and 24 non-DDT pesticide compounds (n = 31) were in the highest group for shortfin mako (similar to white shark but higher than thresher and salmon sharks), containing 40.2 ± 37.3 ug/g of DDT and 1.9 ± 1.6 ug/g of pesticides. DDT and non-DDT pesticides show the parabolic relationship described above, indicative of maternal offloading and habitat differences between young and adult shortfin mako (Lyons et al. 2019b, at 7002–04). Even though adult shortfin mako sharks may spend a considerable amount of time offshore, coastal food sources like California sea lions, harbor seals and northern elephant seals may be such an important food source, and California has such a strong pesticide signature, that adult shortfin makos accumulate excessively high rates of pesticides. Maternal offloading means that "management models factoring in contaminant accumulation can no longer assume YOY [young-of-the-year] sharks are receiving a 'fresh start' at birth since sharks may be most susceptible to contaminant exposure at this age" (Lyons et al. 2013, at 36).

4. Other pollutants

Finally, several notable other toxic compounds have also been found in shortfin mako. One study from the mid North Atlantic Ocean reported an average arsenic concentration of 1.71 mg/km wet weight (n = 4) a level substantially higher than the legal limit of 0.1 mg/kg wet weight set by the Joint FAO/WHO Expert Committee (Torres et al. 2017, at 205, 208–09). This study also tested shortfin mako shark for cadmium and lead but found that these metals were below detection levels in all sizes of mako individuals (Torres et al. 2017, at 203–04). Two polychlorinated compounds structurally related to Dechlorane 603, an analogue of the chlorinated flame retardant Dechlorane Plus, were confirmed in 22 out of 24 livers of shortfin mako sharks caught by the Cape Canaveral Scientific Inc. from offshore waters from southern Maine to New York in the western North Atlantic Ocean (n=25, 2008–2014).

Although contaminant concentrations can vary in animals depending on exposure, shortfin mako sharks show remarkable consistency in high concentrations between individuals. A study from the Southern California Bright reported 76–78% similarity in contaminant profiles between individuals (Lyons et al. 2013, at 30). This indicates that all sampled mako (n = 31 in the study) reported similar, high levels of PCBs, DDT and other pesticides and mercury.

One study summed up the impacts of bioaccumulants well:

> Currently, the magnitude of contaminant accumulation in species is not incorporated into species risk assessments or management considerations. While contaminant effects in elasmobranchs remain unclear in general, environmental contaminant exposure in a smaller elasmobranch (Round Stingray *Urobatis halleri*) has been found to negatively impair several physiological functions, including its ability to mount a normal primary (e.g., increase of plasma 1α-OH-corticosterone) and secondary (e.g., increase of plasma glucose) stress response. If contaminant level is correlated with its effect in species, we might predict . . . higher probabilities of negative effects in a species like the Mako Shark. As a high-performance fish caught for sport, the ability of Makos to mount a proper stress response is crucial for its postrelease survival, and any impairment to a proper stress response could potentially exacerbate anthropogenic interactions.

(Lyons et al. 2019, at 7004 (citations omitted)).

As a result of the impacts of PCBs, pesticides like DDT, mercury, arsenic, and other pollutants, shortfin mako are likely experiencing reduced individual fitness, population decline, and synergistic threats with other pollutants and parasites. Because these toxic contaminants are already present in the oceans, and will continue to be deposited there over time, PCBs and mercury represent both present and future threats to the shortfin mako's habitat (Gelsleichter & Walker 2010, at 492–96).

B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

The main threat to the shortfin mako is fishing. The species is both targeted and bycaught by commercial fisheries, particularly by pelagic longliners fishing for tuna, billfish, and swordfish in national and international waters (Camhi et al. 2008, at 166–86; Campana 2016, at 1599–1600). The

shortfin mako is valued for its high-quality meat, fins, and other products, and thus is retained more frequently than other pelagic sharks (James et al. 2016, at 8; *see generally* Dent & Clarke 2015). The species is also a target of sport fisheries in the United States, Australia, and some European countries (Casey & Kohler 1992, at 45–47; CoP18 Prop. 42 2019, at 7; French et al. 2015, at 1). In this Petition, we focus on the primary sources of mortality for the shortfin mako, commercial and recreational fishing.

1. Overutilization for Commercial Purposes

Overwhelmingly, the dominant threat to the shortfin mako shark globally is historic and ongoing commercial fishing. The species is targeted and bycaught throughout its range. It is the second most common oceanic shark caught by high-seas longline and net fisheries, especially those pursuing tuna, billfish, and swordfish (Camhi et al. 2008, at 166–86; Campana 2016, at 1599–1600). Ecological Risk and Productivity Assessments determined that the shortfin mako was the second most vulnerable shark species to overexploitation in pelagic longline fisheries in the Atlantic Ocean and the most vulnerable one in the Indian Ocean (IOTC 2017, at 154–55). Two ecological risk assessments ("ERAs") ranked the shortfin mako as the second most vulnerable shark to over-exploitation by Atlantic longline fisheries out of 12 species (Cortés et al. 2010, at 25–34). A follow-up review to one of these ERAs (Cortés et al. 2010), showed that the shortfin mako was the most susceptible shark species to pelagic longline fisheries in the Atlantic Ocean and among the most vulnerable species based on its biology (Cortés et al. 2015, at 2637). Longline fisheries alone kill shortfin mako sharks at unsustainable rates estimated at three times (3x) above limits of scientific advice (Sims et al. 2018, at 1342), and 5–18x greater than estimates of maximum sustained yield (Byrne et al. 2017, at 4). The shortfin mako shark is susceptible to four types of fishing-induced mortality: (1) landing, (2) finning (discarding sharks alive after removing the fins), (3) unintentional capture (hooking) mortality, and (4) post-release mortality.

Shortfin mako are most commonly caught as bycatch by industrial longline and gillnet fisheries (Camhi et al. 2008, at 166–86; Campana 2016, at 1599–1600), although pressure is also created by commercial trammel nets and trawls (Beutel et al. 2008, at 193–94), and artisanal fisheries (Martínez-Ortiz et al. 2015, at 17; Sosa-Nishizaki et al. 2014, at 1–6). An analysis of FAO global catch production statistics from 1981–2016 report that total landings of shortfin mako increased by 69% from 2004–2009 (total of 54,155 t during the period, average annual catch of 9,025 t) to 2010–2016 (total 45,956 t, average annual 12,141 t) (CoP18 Prop. 42 2019, at 9). From 2010–2016 fisheries in the Atlantic Ocean contributed to 50% of total catches (45,956 t), the Pacific amounted to 34% (31,838 t) and the Indian Ocean to 15% (14,043 t) (Figure 15).

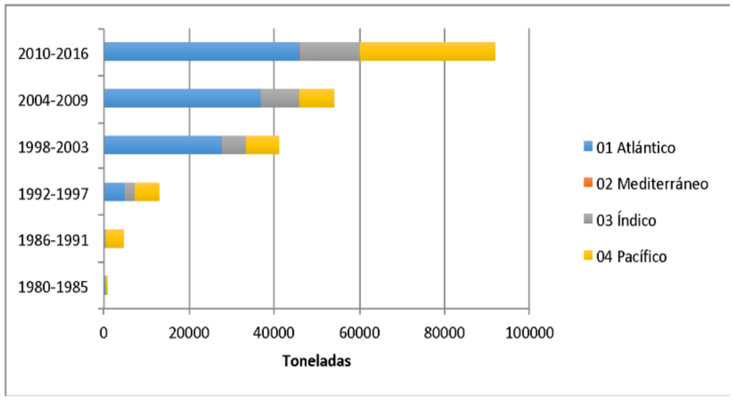

Figure 15. Global catch of shortfin mako shark from 1981–2016 in tonnes by region (CoP18 Prop. 42 2019, at 21).

Alarmingly, globally shortfin mako experienced the third greatest increase in landings (3,052 tonnes) of all reported shark and ray species between 2003 and 2011 (Davidson et al. 2016, at 448). Although landed sharks are generally recorded by most fishing nations and accounted for in stock assessments or yield calculations, these numbers represent only minimum amounts of landings due to the 75% of catch that is estimated as unreported (Campana 2016, at 1599–1607).

Under-reporting of catches likely occurs in pelagic and domestic fisheries and means that landing data represents a considerable underestimate. One study from the North Atlantic estimated that only 25% of the total catch is being reported to ICCAT (Campana 2016, at 1604). Such under-reporting in fishing logbooks prevents a clear understanding of the degree of bycatch, and biases stock assessments based on these data. This discrepancy appears to be primarily a result of illegal, unregulated, and unreported ("IUU") fishing, worth an estimated $192 million per year for sharks alone, which is adversely affecting the shortfin mako (HSTF Report 2006, at 18). Therefore, while catch data are useful in showing trends indicating increasing catch or decreasing CPUE, true total catch amounts are substantially higher than those reflected in fisheries statistics. Furthermore, "targeting of pelagic sharks is increasing due to declines in traditional target species, high value of fins for most species, and/or high or rising value of meat" (Simpfendorfer et al. 2008, at 4). Thus, directed fisheries represent an increasing threat as traditional target species continue to dwindle.

Although landing data is a significant underestimate, it can provide a rough approximation of the substantial mortality faced by shortfin mako associated with fishing fleets. Research indicates that 20–40% of longline-hooked makos die on the line, even before they are brought on deck. This is in part because the shortfin mako is an obligate ram ventilator, meaning that it requires constant movement to obtain oxygen and so often asphyxiates when bycaught (Campana 2016, at 1603; Campana et al. 2016, at 525). Global retention rates for shortfin mako average 100% (95% confidence intervals of ~85-100%; n = 56 studies) with a primary range of greater than 60%, ranking the shortfin mako as one of the 2 highest retention rates among 11 taxa investigated (Figure 16 (citing James et al. 2016)). An assessment of mako (including shortfin and longfin) caught by longline fisheries in the western and central Pacific Ocean estimated ~45% as retained and ~25% as finned (Figure 17 (citing Clarke et al. 2013)). Out of the individuals that are not retained by commercial fisheries, 17-47% are likely to die after release (Table 2). As a result of this high fishing pressure and fishing-caused mortality, combined with a lack of international catch quotes, shortfin mako populations are rapidly declining (Campana 2016, at 1602; Sims et al. 2018, at 1342).

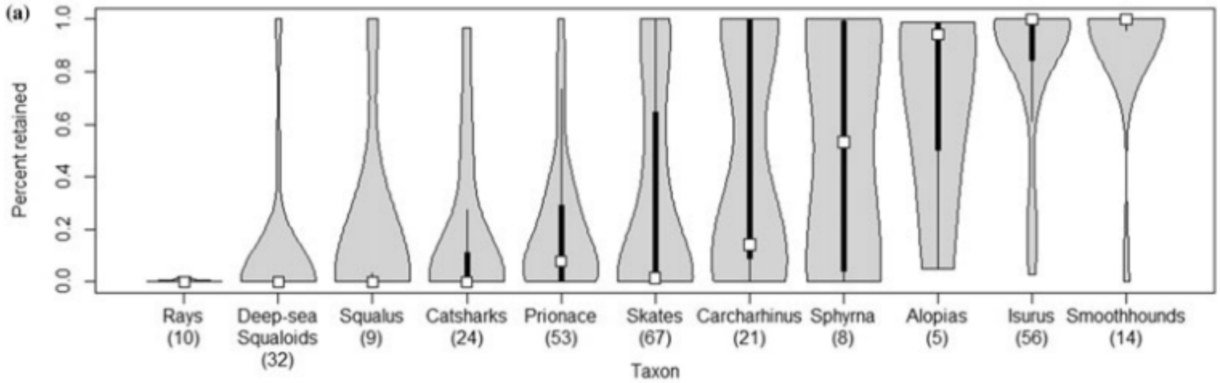

Figure 16. Violin plot of percent catch retained by taxonomic group, showing *Isurus* (including both shortfin and longfin mako sharks) among the two taxa with the highest retention rates (median 100%) (James et al. 2016, at 7). The white square is the median, the black vertical bars are interquartile ranges with 95% confidence intervals extended as black lines, and the grey fill represents the kernel density estimation. Sample size is in parentheses.

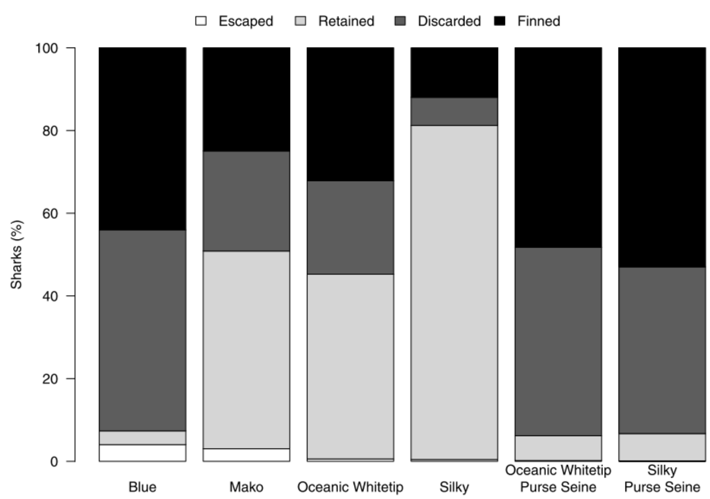

Figure 17. Mako sharks (including shortfin and longfin) fate reported by observers from 1995 through 2010 for the western and central Pacific Ocean for longline (Clarke et al. 2013, at 11).

After release, mako face the potential of post-release mortality, or dying after release from injuries or stress. While the shortfin mako exhibits less primary post-release mortality than some other shark species, mortality is still high (Musyl & Gilman 2019, at 478). A meta-analysis of 4 studies and 5 mortality samples found an effect size of post-release mortality across studies to be 25.4% (15 out of 67 individuals) (Musyl & Gilman 2019, at 478), with study findings ranging from 10.0% to 44.4% (Abascal et al. 2011, at 1181; Campana et al. 2016, at 523; French et al. 2015, at 1; Musyl et al. 2011, at 344; *see* Figure 18). Table 2 shows post-release mortality findings from various studies, including those assessed in the meta-analysis. These rates must be accounted for mortality and recovery estimates to increase accuracy in stock assessments and MSY calculations (Campana 2016, at 1605).

Several fishing practices can influence the mortality rates of sharks. Post-release mortality is affected by the type of fishing hook used, although the effect is still under research and debate. ICCAT

recently recommended that circle hooks should be explored as an alternative to J-hooks to reduce mortality of makos captured by fishing vessels (ICCAT 2019a, at 14). Some research has suggested that circle hooks can reduce mortality (Musyl et al. 2011, at 356). However, an ICCAT study comparing hook mortality found that total mortality was 1.6 times higher when circle hooks were used as opposed to J-hooks (although this study was a coarse back-of-the-envelope calculation based on two prior studies) (Semba et al. 2018, at 435). Other variables can also affect the at-vessel and post-release mortality, including time spent hooked on the line (longer times increase stress and vulnerability to predation), fight time, leader material, fish size, and handling and discard practices (Musyl et al. 2011, at 342). A recent review of, among other things, the effect of hook type on post-capture mortality found inconclusive results, though some evidence that circle hooks reduced post-capture mortality (Keller et al. 2020, at 1).

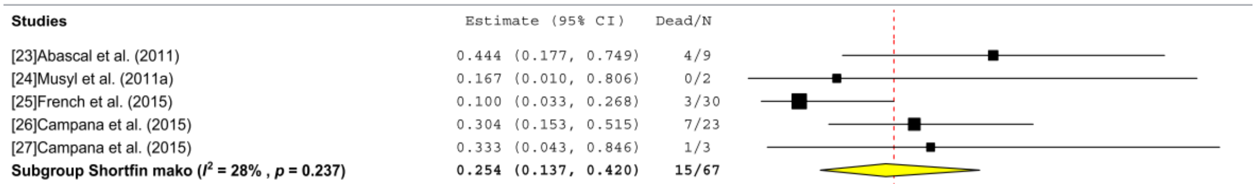

Figure 18. Meta-analysis results showing effect size of post-release mortality in shortfin mako released from fishing gear (Musyl & Gilman 2019, at 478). Horizontal lines represent 95% confidence intervals for each study and the yellow diamond represents the summary effect size across studies, with more narrow widths indicating greater precision in the estimate. I^2 indicates the amount of variability among studies within species and p-value shows result of test for heterogeneity. Red vertical line shows the average across 8 species of pelagic sharks.

Post-release mortality (95% CI)	**Dead/N**	**Location**	**Details**	**Citation**
47.0%		Hawaii, U.S.	Deep water commercial fisheries	(Walsh et al. 2009)
44.4% (18–75%)	4/9	Chile		(Abascal et al. 2011)
33.3% (4–85%)	1/3	Northwest Atlantic	Unhealthy or injured individuals	(Campana et al. 2016)
31.6%		Hawaii, U.S.	Shallow water commercial fisheries	(Walsh et al. 2009)
30.4% (15–52%)	7/23	Northwest Atlantic	Healthy individuals	(Campana et al. 2016)
22.8%	8/27	Atlantic Ocean (Brazilian, Portuguese, Spanish, Uruguayan and U.S. vessels)	Satellite tagging study	(Miller et al. 2020)
17% (1–81%)	0/2	Hawaii, US	See (Musyl and Gilman, 2019) for methods	(Musyl et al. 2011)

10.0% (3–27%)	3/30	Tasmania, Australia	Recreational fishing	(French et al. 2015)

Table 2. Post-release mortality findings from studies based primarily on commercial fisheries and one study of recreational fishing (French et al. 2015).

Shortfin mako are "very marketable with highly valued meat . . . and high quality fins," (James et al. 2016, at 8), and are commonly harvested for their meat and fins (Liu et al. 2013, at 2; *see generally* Dent & Clarke 2015). The meat is utilized fresh, frozen, smoked, and dried-salted for human consumption. The fins of the shortfin mako are commonly traded, composing 1.2% of the fin imported during 2014 into Hong Kong, the world's largest shark fin entrepôt (Fields et al. 2018, at 376). Shortfin mako fins also made up 4.16% and 2.37% in the fin markets in Guangzhou and Hong Kong respectively (Cardeñosa et al. 2020, at 8). The liver oil, teeth, jaws, and skin are also used (Clarke et al. 2006a, at 209). For example, shark liver oil is highly valuable in the cosmetic industry as a moisturizer (Cardeñosa 2019, at 1383). The high value of all these products make the shortfin mako not only a frequently used species but a preferred species especially for its meat and skin in some regions (Clarke et al. 2006a, at 209). Furthermore, the shortfin mako faces compounded pressure as a targeted species motivated by markets for all these products, making it potentially more at risk than species threatened by a single market like finning.

Shortfin mako has also repeatedly been found being sold illegally as a substitution fish for human consumption as well as in pet food. Such mislabeling could not only be considered a wildlife crime but also, and more importantly, indicate mainstream markets for shortfin mako products that generate demand and further motivate retention (legal or illegal) by commercial fisheries. Several studies using molecular barcoding have found high rates of shark substitution for fish in Italian department stores and fish markets, with up to 77.8% of samples being mislabeled (Barbuto et al. 2010, at 379). One such study alarmingly identified shortfin mako meat mislabeled as swordfish, porbeagle, and smoothhound (Filonzi et al. 2010, at 1387). In a study of 87 pet food products from 12 different brands, none of which were labeled as containing shark products, shortfin mako shark was found in 71% (17 products) of pet food samples, the most prevalent species identified by the study (Figure 19 (citing Cardeñosa 2019)).

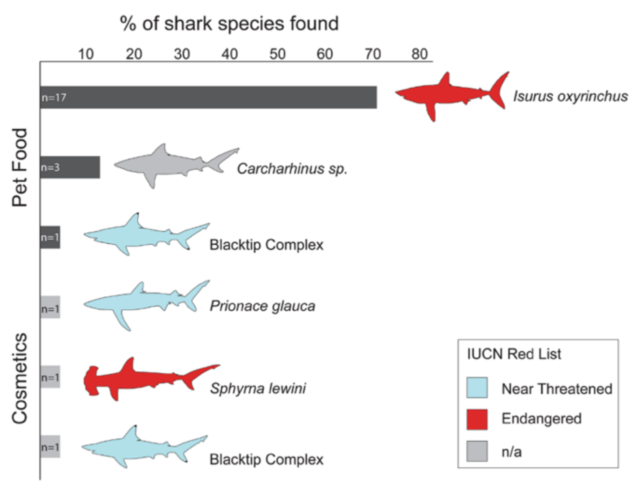

Figure 19. Shortfin mako shark was the most prevalent species detected using genetic techniques in a study on pet food products (treats, wet and dry food), none of which were labeled as containing shark (Cardeñosa 2019, at 1385).

The fin trade is a major force driving both retention of bycatch and directed fishing of shortfin mako. Much of this finning pressure is due to the fact that the shortfin mako is a preferred species in the Hong Kong fin markets, the largest shark fin markets in the world (Fields et al. 2018, at 376) composing 2.7% (95% probability intervals of 2.3–3.1%) of the Hong Kong shark fin trade (Figure 20; Clarke et al. 2006a, at 209). In fact, shortfin mako is so popular that it is one of only 8 shark species dominating the contemporary fin market in Hong Kong (Fields et al. 2018, at 376). As a result of the fin trade, the shortfin mako is subject to "finning," in which the fins of a live shark are cut off and the remainder of its carcass is dumped into the ocean. The estimated number of shortfin mako killed annually to support the international fin trade is between 300,000 to 1,000,000 sharks, totaling between 20,000 and 55,000 tonnes in biomass (Figure 21 (citing Clarke et al. 2006b)). Assessments in the North and South Pacific Ocean indicate that shortfin mako in longline fisheries are more likely to be retained than finned, which indicates that shark finning prohibitions do not address the primary source of mortality for this species (Clarke et al. 2013, at 1).

Species	Common name	Meat	Fins[b]	Skin	Liver oil	Other[e]
Alopias pelagicus	Pelagic thresher	✔	✔ (2.3%)[c]	✔		
Alopias superciliosus	Bigeye thresher	✔	✔	✔		
Alopias vulpinus	Thresher	✔+	✔	✔	✔	
Carcharhinus falciformis	Silky shark		✔ (3.5%)		✔	
Carcharhinus longimanus	Oceanic whitetip shark		✔ (1.8%)	✔	✔	
Carcharodon carcharias	Great white shark		✔	✔	✔	teeth, jaws
Cetorhinus maximus	Basking shark		✔	✔	✔+	
Pteroplatytrygon violacea	Pelagic stingray					
Isurus oxyrinchus	Shortfin mako	✔+	✔ (2.7%)	✔+	✔	teeth, jaws
Isurus paucus	Longfin mako		✔		✔+	
Lamna ditropis	Salmon shark	✔	✔		✔	
Lamna nasus	Porbeagle shark	✔+	✔	✔+	✔	
Mobula spp.	Devilrays	✔				gills
Prionace glauca	Blue shark	✔	✔ (17.3%)	✔		
Rhincodon typus	Whale shark	✔	✔	✔	✔	gills
Sphyrna spp.	Hammerheads	✔	✔ (5.9%)[d]	✔+	✔+	

[a] ✔: frequently used; ✔+: preferred species, can vary regionally (from Rose 1996; Clarke *et al.* 2005).
[b] Percentage of world trade (in parentheses) is based on reported proportions in the Hong Kong shark fin market (Clarke *et al.* 2006b).
[c] Percentage for all three thresher shark species.
[d] Percentage includes three hammerhead species: smooth *Sphyrna zygaena*, scalloped *Sphyrna lewini* and great *Sphyrna mokarran*.
[e] These are the preferred species for the listed products: CITES 2002; Rose 1996; White *et al.* 2006.

Figure 20. Shortfin mako fins are among the most popular in the Hong Kong fin markets. Shortfin mako are frequently used for meat, skin, liver oil, teeth, and jaws, and are preferred species in some regions for meat and skin (Camhi et al. 2007, at 20–23). Shortfin mako are estimated to compose an average of 2.7% (95% probability intervals of 2.3–3.1%) of the Hong Kong shark fin trade (Clarke et al. 2006a, at 209).

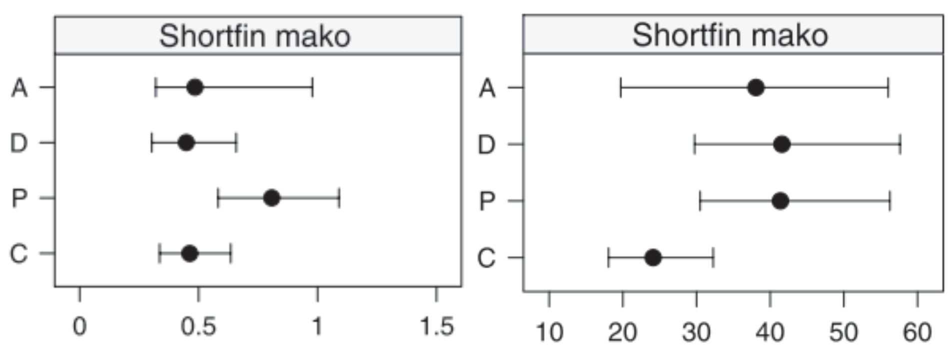

Figure 21. Estimate of the number (left, in millions) and biomass (right, in thousand tonnes) of shortfin mako utilized each year in the shark fin trade worldwide. Fin positions are abbreviated as:

dorsal (D), pectoral (P), caudal (C), and all fin positions from a mixture distribution (A) (Clarke et al. 2006b, at 1121).

While it is true that Asia is the primary consumer of shark fins, including those from shortfin mako (Liu et al. 2013, at 1–6), the United States is ranked as one of the top fishers, importers and exporters of shark products, including fins (Murdock & Villanueva 2019, at 1–30). The global shark fishery is primarily driven by 20 countries, with the United States ranked as the seventh (Fischer et al. 2012, at 10) or eighth (Lack & Sant 2011, at 6–7) highest based on reported shark catch, responsible for at least 3.7% of global shark catch reported to FAO, representing 30,686 tons of live weight catch annually (2000–2008) (Lack & Sant 2011, at 6–7). The United States is also both the ninth highest importer (334 tonnes in 2000–2009) and ninth highest exporter (1,941 tonnes) of shark fins in the world (Mundy-Taylor & Crook 2013, at 66). Shortfin mako has been identified in shark fin soup sampled from restaurants in Chicago, Illinois and Albuquerque, New Mexico (Nalluri et al. 2014, at 645–46). Although finning was made illegal in U.S. waters in 2000, finning rates of 0.1% were still reported from 2004–2006 from Hawaii-based longline fisheries, indicating that finning continued to be recorded by fishery observers (Walsh et al. 2009, at 278).

Shortfin mako also experience indirect impacts of fishing. As one example, the sharks can become entangled in discarded fishing gear, which can cause injury or death. A shortfin mako found entangled in a three-strand twisted natural fiber rope for more than 5 months caused deep abrasions, scoliosis of the back, and undernourishment (Figure 22 (citing Wegner & Cartamil 2012)). Such indirect impacts further compound the effects of fishing on shortfin mako by affecting foraging, reproduction, and survivorship, in addition to raising serious concerns about animal welfare.

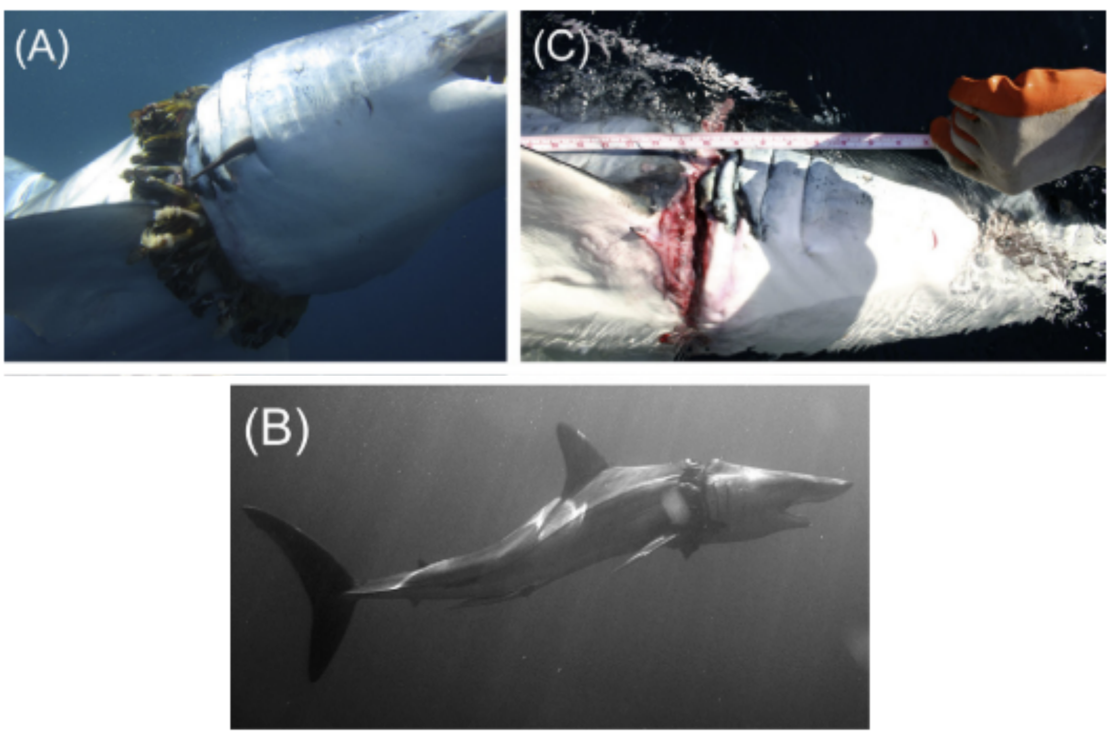

Figure 22. A shortfin mako entangled by a rope off the coast of San Diego, California. Images show: (A) entanglement, (B) unnaturally large mouth gape and scoliosis of the back, and (C) a lateral view with the rope removed (Wegner & Cartamil 2012, at 392–93).

Commercial fishing places such severe pressure on shortfin mako because of how fishing dynamics combine with the species' low productivity. The individuals most frequently caught by fishing vessels are juveniles of 3–10 years (Winker et al. 2020, at 318–20), as these individuals often reside in nurseries near high-productivity coastal regions. The harvesting of juveniles has serious population-level ramifications, because individuals are removed from the population before they can reproduce (Vaudo et al. 2017, at 1773). Shortfin mako may be particularly vulnerable to this dynamic (Cortés et al. 2015, at 2644–45 (highly vulnerable species)). Catch of individuals before they have an opportunity to reproduce reduces the species' ability to replace lost individuals and hampers its ability to recover from population declines. This catch of immature individuals is therefore an unsustainable practice that exacerbates the overutilization threat that the shortfin mako is experiencing. Population growth is further delayed by the species' late age of sexual maturity (approximately 18+ years in females), long, three-year reproductive cycle and longevity of 29 years, meaning that population recovery will take many decades (*see* Section III.F. Reproduction and Lifespan).

The overutilization threat discussed in this section is the primary driver of the shortfin mako population declines (*see* Section III.G. Population Trends). While population trend data is not available throughout the shortfin mako's range, where it is available it shows extreme declines over short periods of time for all but one population. Furthermore, all, or nearly all, of the datasets available do not have information on the species' historical abundance and therefore underestimate the decline that the shortfin mako has experienced from its historical numbers. This makes the observed declines far more alarming as these populations have already been exploited for decades before the analyzed data sets began (Baum et al. 2003, at 389).

The United States recognized overexploitation as a major driver of declines in the shortfin mako, especially in the North Atlantic population—in its 2019 proposal to ICCAT calling for Contracting Parties and Cooperating non-Contracting Parties, Entities or Fishing Entities ("CPCs") to take immediate and significant efforts to limit overfishing, reduce total mortality, and rebuild the stock (ICCAT U.S. Explanatory Note 2019, at 2–4). This proposal recommended that "a rebuilding program shall be implemented to end overfishing immediately and rebuild North Atlantic shortfin mako to biomass levels sufficient to support maximum sustainable yield by 2017" (ICCAT U.S. Explanatory Note 2019, at 4 (text defining acronyms omitted)). Though the criteria for designating a species threatened or endangered is different from that of defining a fish stock as overfished, there is typically close agreement between these categories (Davis & Baum 2012, at 1–8).

a. North Atlantic Ocean

There are currently no directed fisheries of shortfin mako in the North Atlantic (Campana 2016, at 1603). Pressure from fisheries in the North Atlantic Ocean results from shortfin mako being killed as bycatch, usually by pelagic longlines targeting swordfish, tuna, and billfishes and by recreational sport fishing.

The Atlantic (North and South) represented 50% (a total of 45,956 t) of reported global catches from 2004–2009, according to FAO data (CoP18 Prop. 42 2019, at 9). Reported catches of shortfin mako in the North Atlantic exceeded 3,300 t in 2016 (mainly by longline vessels) CoP18 Prop. 42 2019, at 9 (citing ICCAT 2017a)), which amounts to 130,000 individuals (CoP18 Prop. 42 2019, at 9 (citing Sims et al. 2018)). However, as discussed in the above section, catches represent an

underestimate only and landing data do not reflect the number of sharks finned and discarded at sea or which experience post-release mortality. The United States reported the 3rd highest catch in 2016 in the North Atlantic, representing 9% of total catch, exceeded only by Spain (47%) and Morocco (31%) and followed by Portugal (8%). Fisheries in the North Atlantic may have placed pressure on the shortfin mako since the early 1960s, when U.S. and Canadian longline fisheries for swordfish in the Atlantic began in this area, and increased in the 1970s, when the U.S. swordfish fishery expanded significantly. U.S. fisheries currently extend over much of the western North Atlantic from the Grand Banks to the equatorial zones of South America (Casey & Kohler 1992, at 48).

In Mexico, shortfin mako is primarily caught by artisanal and medium-size longline fisheries targeting pelagic sharks or swordfish (CoP18 Prop. 42 2019, at 9 (citing Sosa-Nishizaki et al. 2017)). In the Gulf of Mexico, shortfin mako are caught as bycatch in longline vessels targeting red snapper or other shark species, and there is no targeted catch of shortfin mako. In Canada, all landed sharks are exported to international markets (CoP18 Prop. 42 2019, at 9). In Bermuda (United Kingdom), landings of shortfin mako have ranged between 0–5 individuals annually (up to 345 kg/year), and these catches are not traded internationally (CoP18 Prop. 42 2019, at 9).

A study using satellite telemetry as a tool for documenting fishing interactions quantified the fishing mortality of shortfin mako in the North Atlantic Ocean (Byrne et al. 2017). The authors tracked 40 sharks from 2013–2016 in the Yucatan peninsula, Mexico and Maryland, United States, then estimated the probability of survival of sharks annually. They estimated fishing mortality ranged from 0.19 to 0.56, 5–18 times higher than the estimated mortality at maximum sustainable yield, which ranges from 0.031 to 0.038 (CoP18 Prop. 42 2019, at 5 (Byrne et al. 2017)).

The 2017 ICCAT stock assessment for North Atlantic shortfin mako used four models with data from 1950–2015 and reported a 90% probability of the stock being overfished and experiencing overfishing (CoP18 Prop. 42 2019, at 5 (citing ICCAT 2017a)). This was updated in the 2019 ICCAT stock assessment, which is considered a more accurate representation of stock dynamics than previous assessments, as the 2019 model incorporated aspects of shortfin mako biology not included in prior models. The 2019 assessment projects that regardless of total allowable catch ("TAC"), the stock will continue to decline until 2035 before any biomass increases can occur (ICCAT 2019a, at 9). Stock Synthesis projections show there is a long lag time between when management measures are implemented and when stock size starts to rebuild. Projections indicate that a zero TAC will allow the stock to be rebuilt and avoid overfishing by 2045 with 54% probability; a TAC of 700 tons would end overfishing immediately with a 57% probability but would only have a 41% probability of rebuilding the stock by 2070 (Figure 23). To rebuild the stock with at least a 60% probability by 2070, the realized TAC must be 300 tons or less. Projections exploring different management measures with the Decision Support Tool revealed that if fishers are unable to avoid catching shortfin mako and those discarded have a substantial mortality rate, it will be necessary to greatly decrease the retained catch to allow the stock to rebuild.

C. Probability of both $F < F_{MSY}$ and $SSF > SSF_{MSY}$

TAC (t)	2019	2020	2025	2030	2035	2040	2045	2050	2055	2060	2065	2070
0	46	42	24	14	11	33	53	60	63	67	72	81
100	46	42	24	13	10	29	49	56	59	61	66	73
200	46	42	24	13	9	26	47	54	55	57	61	66
300	46	42	24	12	9	22	42	50	52	53	56	60
400	46	42	24	12	8	19	39	47	49	50	52	55
500*	46	42	24	12	7	17	34	42	45	47	49	52
600	45	42	24	12	7	14	28	37	40	41	43	47
700	41	41	24	11	6	11	23	31	34	35	37	41
800	27	34	23	11	6	10	19	26	27	28	30	32
900	14	21	23	11	5	8	15	20	21	21	23	24
1000	5	10	20	10	5	7	12	15	15	14	14	16
1100	2	4	14	9	4	5	7	9	9	8	8	8

*Largest TAC interval with ≥ 50% by 2070

Figure 23. ICCAT 2019 stock assessment Stock Synthesis model runs for the North Atlantic shortfin mako. This table features predicted percent TAC (in tons) if fishing mortality and spawning stock fecundity are kept at levels such that harvests are lower than maximum sustainable yield ("MSY") and which enable shortfin mako shark populations to begin to recover (ICCAT 2019a, at 23).

Given the lag time due to the biology of the shortfin mako between when a TAC is implemented and when spawning stock biomass begins to increase, the Standing Committee on Research and Statistics ("SRCS") recommended that the ICCAT adopt a non-retention policy without exception in the North Atlantic—essentially a ban on retention (ICCAT 2019a, at 15). They also recommended that CPCs report all sources of mortality as an essential part of decreasing uncertainty in stock assessment results. "The report of dead discards and live release is of the utmost importance particularly if the Commission adopts a non-retention strategy" (ICCAT 2019a, at 15). However, due to at-vessel and post-release mortality (*see* Section IV.B.1. Overutilization for Commercial Purposes), a no-retention requirement is not expected to reduce mortality enough to stop overfishing and rebuild the stock. Additional efforts are required, and the SRCS recommended gear modifications and time/area closures along with safe handling and release practices to further reduce mortality and enable rebuilding of the shortfin mako population.

b. South Atlantic Ocean

The Atlantic (North and South) represented 50% (a total of 45,956 t) of reported global catches from 2004–2009, according to FAO data (CoP18 Prop. 42 2019, at 9). Reported catch in the South Atlantic exceeded 2,600 t in 2016 (ICCAT 2017a), although this is likely a considerable underestimate given underreporting (Campana 2016, at 1603). The 2017 ICCAT assessment reported that it was highly likely in recent years that the number of females in the shortfin mako stock had been below the level expected at MSY and that fishing mortality already exceeded expected mortality at MSY (ICCAT 2017a). It concluded this despite the assessment models reporting a 19% probability that the stock is overfished and experiencing overfishing, due to the high uncertainty associated with this model.

The 2019 ICCAT assessment models indicated a combined probability of the stock being overfished of 32.5% and the probability of the stock experiencing overfishing of 41.9%. The Kobe pie chart summarizing South Atlantic shortfin mako stock status showed that 34% of the stock was

characterized as "overfished *or* experiencing overfishing" and 28% were "overfished and experiencing overfishing." (ICCAT 2019b, at 226, 254 (emphasis added); Figure 24). Model estimates of unsustainable harvest rates were considered "fairly robust", although results overall were considered highly uncertain. To reduce the risk of a decline in stock in the South Atlantic as in the North, ICCAT recommended that at a minimum catch levels should not exceed the minimum catch in the last five years of the assessment, or 2,001 t (ICCAT 2019b, at 230). This assessment acknowledged that the fishery development in the South Atlantic predictably follows that in the North Atlantic and the biological characteristics of the stock are similar.

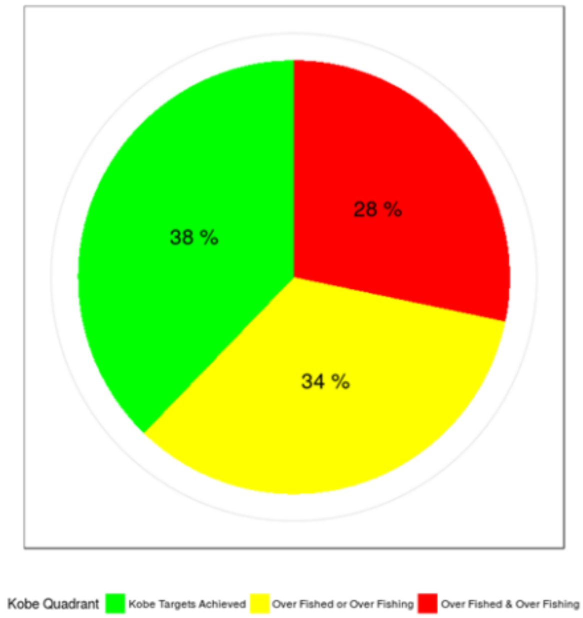

Figure 24. Kobe pie chart summarizing stock status (for 2015) for South Atlantic shortfin makos based on a Bayesian production model and a catch-only model (ICCAT 2019b, at 254).

c. North Pacific Ocean

Mako sharks (both shortfin and longfin) are one of the most commonly-captured shark species in the longline fisheries of the western and central Pacific Ocean. Longline fishing effort in this region has increased steadily from 1995 to 2014 to approximately 800 million hooks, with nearly half of the effort occurring at latitudes offshore Southeast Asia (Rice et al. 2015, at 10). Prior to February 2011, fishing vessels were not required by the Western & Central Pacific Fisheries Commission ("WCPFC") to provide data on shark catch, although since then data for 14 key shark species has been mandatory. This in part explains why in an analysis of longline observed shark catch and effort, only 41% of the pixels recorded sharks and only 16% provided species-specific shark catches (Rice et al. 2015, at 10). Thus, it is impossible to create an accurate depiction of changes in catch and fishing pressure on shortfin mako shark over time in the Pacific Ocean.

That said, the Pacific (North and South) represented 34% (a total of 31,838 t) of reported global catches from 2004–2009, according to FAO data (CoP18 Prop. 42 2019, at 9). Mako sharks were encountered in longline sets in all regions that observers have sampled (Figure 25 (citing Rice et al. 2015, at 67)). More than half of mako individuals were retained or finned rather than discarded (Figure 26). Analysis of existing data from 1995–2014 showed that the largest and most consistent

hotspots of shortfin and longfin mako (combined) catch were between Australia and New Zealand (Region 5) (Figure 27 (citing Rice et al. 2015, at 62)). The north and west regions (Regions 2 and 3) showed stable or slightly increasing rates in the Proportion-presence and High-CPUE indicators (note that data for Region 2 is missing for years 2012–2014), whereas the south regions (Regions 5 and 6) showed steadily declining rates (Figure 27). CPUE has steadily decreased between 1995 and 2014 (Figure 28). An indicator for CPUE ranked mako as increasing in two out of the five regions with sufficient data, and for the Biological Indicator (assessment of sex ratio, median length, standardized length and life history stage and sex) as decreasing in two of the five regions (Figure 29).

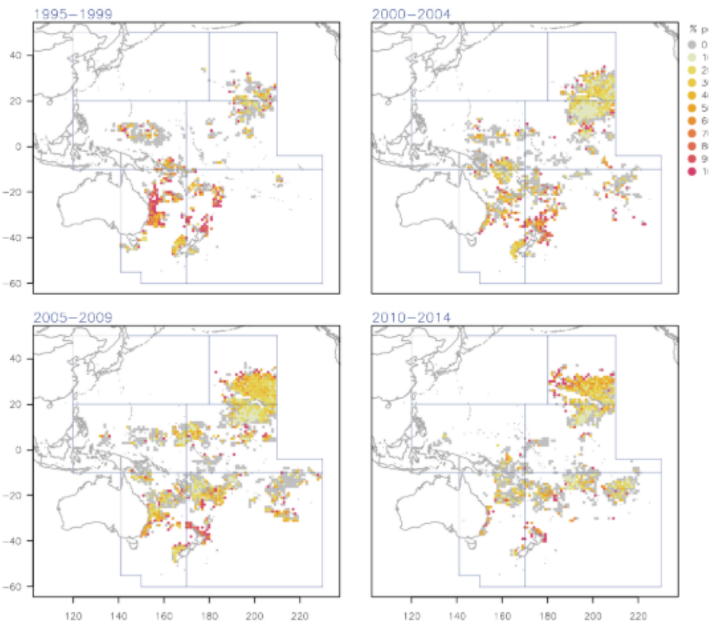

Figure 25. Spatial distribution of the proportion of longline sets for which one or more mako (shortfin and longfin combined) shark were caught for each five-year period between 1995 and 2014 (Rice et al. 2015, at 67).

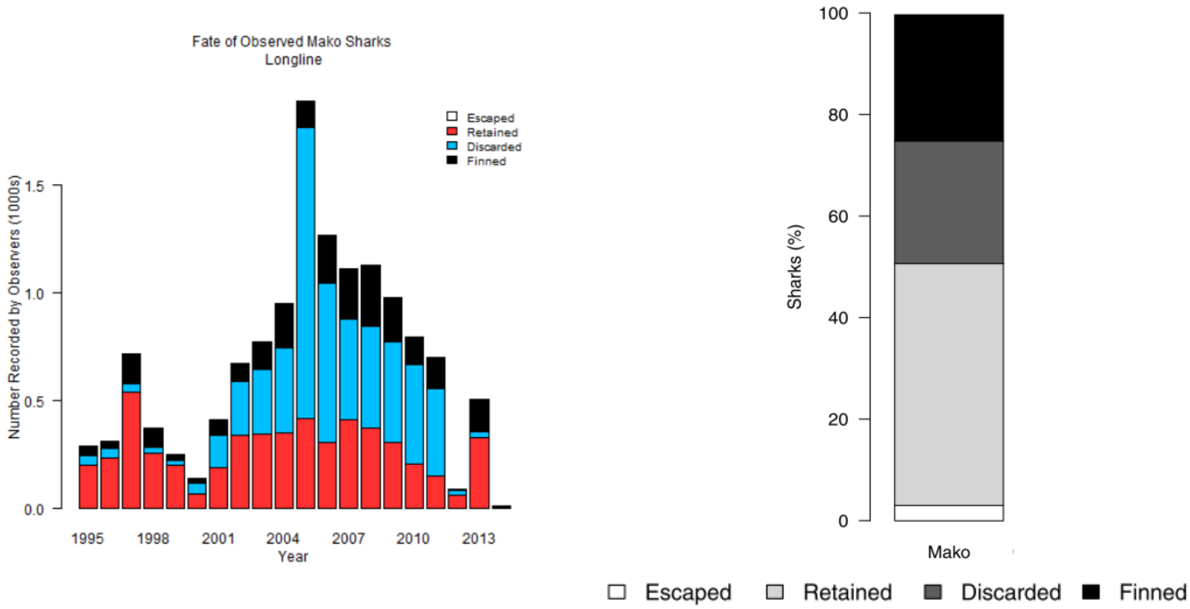

Figure 26. Fate of observed mako (shortfin and longfin combined) sharks caught by longline in the western and central Pacific Ocean, from 1995–2013 by year (left) (Rice et al. 2015, at 122), and total from 1995 (right) (Clarke et al. 2013, at 11).

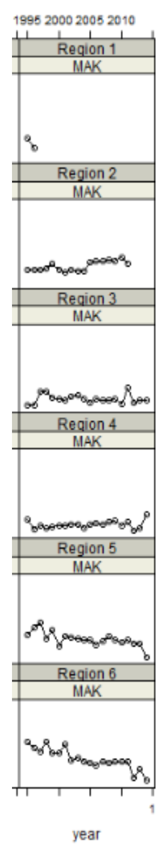

Figure 27. Trend in the proportion of longline sets for which one or more mako (shortfin and longfin combined) were caught by region and year (Rice et al. 2015, at 62).

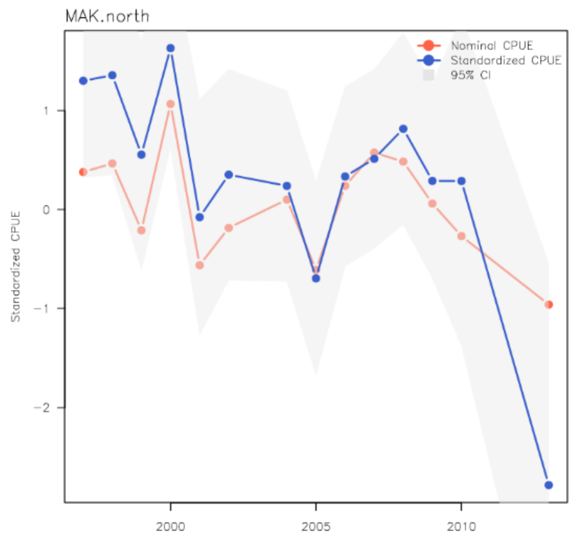

Figure 28. Catch per unit effort ("CPUE") for mako shark (shortfin and longfin combined) in the northern hemisphere of the Pacific Ocean (Rice et al. 2015, at 86). Grey shaded area indicates the 95% confidence interval. Years 2011–2012 were excluded from the standardization due to poor sample sizes.

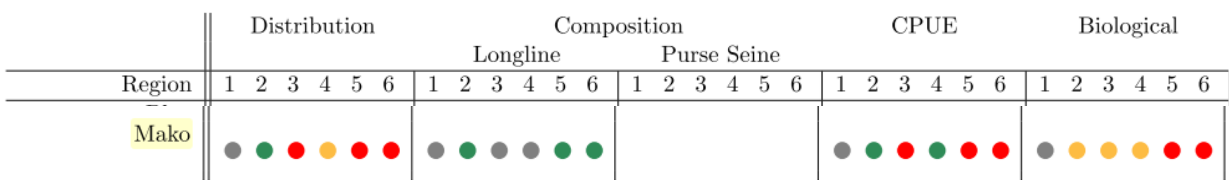

Figure 29. Indicator results for shortfin and longfin mako shark (combined) by indicator category and region. Dots are color coded to identify the direction of trends in each indicator: red – decreasing, green – increasing, yellow – stable, grey – insufficient data. Blank entries indicate where species are caught in relatively very low numbers. Numbers indicate the regions: 1 – Japan/China nearshore, 2 – central North Pacific, 3 – Southeast Asia nearshore, 4 – Mid-Pacific offshore, 5 – Australia/New Zealand nearshore, 6 – South Pacific offshore (subset of figure from Rice et al. 2015, at 53).

In the WPCO, the Hawaii and American Samoa longline fleets catch and retain some portion of mako shark catch. The average catch for the past five years (~2012–2017) is approximately 5,100 individuals, at an annual average of 720 (CoP18 Prop. 42 2019, at 9, 35).

In the Eastern Pacific Ocean, shortfin mako sharks are caught by purse seiners and longliners (CoP18 Prop. 42 2019, at 9). In 2016 the main fleets operating in this area were Ecuador (35%) and Mexico (23%), according to the Inter-American Tropical Tuna Commission (CoP18 Prop. 42 2019, at 9). The Inter-American Tropical Tuna Commission has not reported specific catch data for shortfin mako in the Eastern Pacific Ocean.

An estimate of WCPFC longline catch rates in the North Pacific for mako (shortfin and longline combined) from 1995–2010 indicated that catch declined by 7% (CI 3–11%) annually (Figure 30 (citing Clarke et al. 2013)).

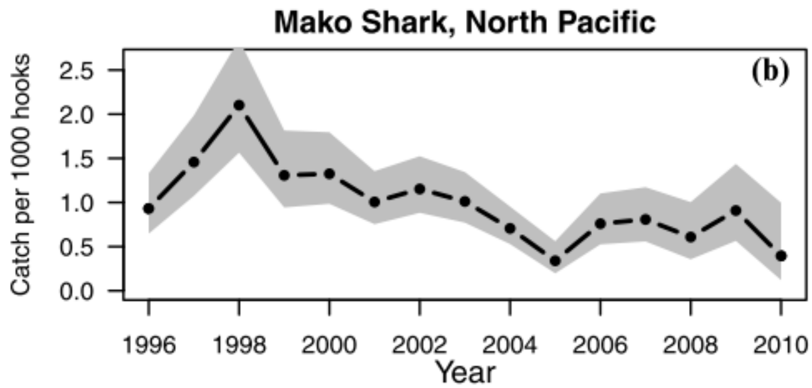

Figure 30. Standardized catch rates for mako in the North Pacific for longlines from 1996–2009 using data from the WCPFC (gray represents 95% confidence intervals) (Clarke et al. 2013, at 7).

d. South Pacific Ocean

The shortfin mako shark is taken as bycatch by commercial fisheries operating in Australian waters and targeting tuna, billfish, scalefish, and sharks. Some of the reported data for this region is captured in Section IV.B.1.c. North Pacific, above, such as for Region 4 (Australia/New Zealand nearshore) and Region 5 (South Pacific offshore). Several ecological risk assessments have ranked the shortfin mako as a high-risk species, including assessments by the gillnet sector (Australian Department of Agriculture Water and the Environment 2014, at 6 (citations omitted)), and tuna and billfish fisheries (Australian Department of Agriculture Water and the Environment 2014, at 6 (citing Patterson & Tudman 2009, at 45)). The Commonwealth-managed fisheries that interact with the shortfin mako are the longline fisheries of the eastern and western tuna and billfish fisheries, and the gillnet and commonwealth trawl sectors of the southern and eastern scalefish and shark fishery (Australian Department of Agriculture Water and the Environment 2014, at 4).

The Pacific (North and South) represented 34% (a total of 31,838 t) of reported global catches from 2004–2009, according to FAO data (CoP18 Prop. 42 2019, at 9). A recent assessment reported that few species-specific catch records of shortfin mako in Commonwealth-managed fisheries are available from prior to the 2000s, consistent with the aforementioned (Section IV.B.1.c. North Pacific) lack of data on shark species catch required by the WCPFC (Australian Department of Agriculture Water and the Environment 2014, at 4). Between 2000 and 2009, the total retained catch of this species in Commonwealth managed fisheries peaked at 133 t in 2001, with median of 69 t. In 2009, the most recent year with a complete dataset, a total of 69 t of shortfin mako were retained by Commonwealth-managed fisheries. Greater than 90% of the 2009 catch was caught in the eastern tuna and billfish fishery (Australian Department of Agriculture Water and the Environment 2014, at 4). Available catch data for Commonwealth-managed fisheries are described in Figure 31, including management measures introduced to mitigate the impacts on sharks over this period.

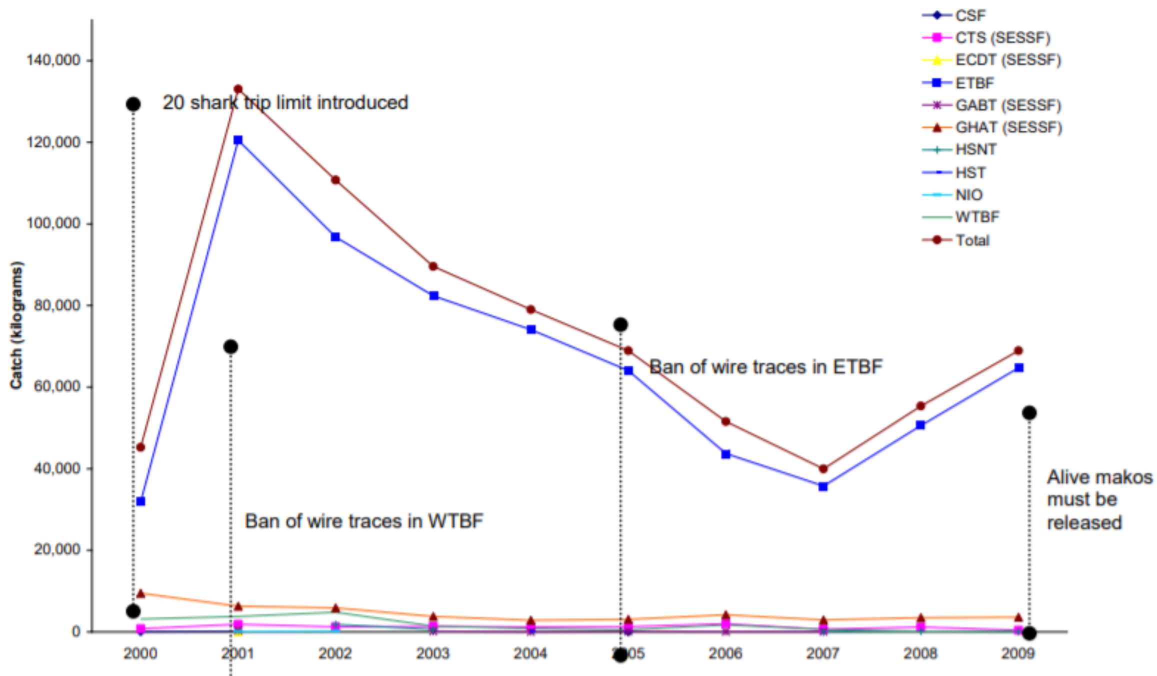

Figure 31. Retained catch weight (kg) of shortfin mako 2000–2009 in Commonwealth managed fisheries (Australian Department of Agriculture Water and the Environment 2014, at 5). These data are not standardized as catch per unit effort ("CPUE") and do not include discarded individuals or recreational catch in Commonwealth waters. CSF – Coral Sea Fishery, CTS (SESSF) – Commonwealth Trawl Sector of SESSF, ECDT (SESSF) – East Coast Deepwater Trawl Sector of SESSF, ETBF – Eastern Tuna and Billfish Fishery, GABT (SESSF) – Great Australian Bight Trawl sector of SESSF, HSNT – High Seas Non-trawl, HST – High Seas Tuna, NIO – Norfolk Island Offshore, WTBF – Western Tuna and Billfish Fishery.

In addition to reported landings, hundreds of individual makos are discarded each year in fishing activities of the eastern and western tuna and billfish fisheries. In 2009, 468 and 575 individuals of the species were discarded in the eastern tuna and billfish fishery and the western tuna and billfish fishery, respectively (Australian Department of Agriculture Water and the Environment 2014, at 5). Given the mortality rates of up to 40% before shortfin mako are even brought to deck (Campana 2016, at 1603) and up to 44% post-release (Abascal et al. 2011, at 1181; Campana et al. 2016, at 520, 523), most of these individuals should be assumed dead.

Following listing of the shortfin mako as a migratory species under Australia's Environment Protection and Biodiversity Conservation Act of 1999 in January 2010, interactions with the species and life status of discards were required to be recorded. The law also requires that live individuals be released unharmed and commercial fishers only retain individuals that are captured dead. In 2010 a total of 3,220 individuals were caught with longline, handline, gillnet, and Danish seine fishing methods, with none recorded as being released alive (Australian Department of Agriculture Water and the Environment 2014, at 4–5). Reported bycatch has significant decreased since, with 129 interactions (92 dead, 28 unknown condition) shortfin mako reported in 2018 (Australian Bureau of Agricultural and Resource Economics and Sciences 2019, at 266).

Commercial fisheries managed by Australian states report relatively low bycatch of shortfin mako. New South Wales began recording catches of makos (shortfin and longfin mako combined) in 1990, reported a peak total catch of 30 t in 1996–1997, and reported between 1–7 t annually thereafter (Australian Department of Agriculture Water and the Environment 2014, at 6 (citing Rowling et al. 2010)). Queensland fisheries recorded a catch of 6.8 t of makos (shortfin and longfin mako combined) in 2008–2009 (Australian Department of Agriculture Water and the Environment 2014, at 6 (citation omitted)). Western Australian reports an annual catch of shortfin mako of less than 5 t (Australian Department of Agriculture Water and the Environment 2014, at 6 (citation omitted)). Tasmanian fisheries between 2000–2009 and Victorian fisheries between 2006–2010 reported <1 t annually (Australian Department of Agriculture Water and the Environment 2014, at 6 (citation omitted)).

Despite the above changes in reported catch, an estimate of WCPFC longline catch rates in the South Pacific for mako (shortfin and longline combined) from 1995–2010 indicated that catch did not show any significant differences across years (Figure 32 (citing Clarke et al. 2013)).

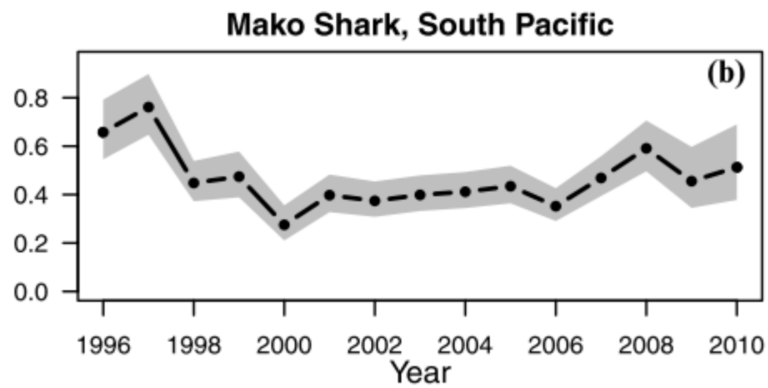

Figure 32. Standardized catch rates for mako in the South Pacific for longlines from 1996–2009 using data from the WCPFC (gray represents 95% confidence intervals) (Clarke et al. 2013, at 7).

e. Indian Ocean

The shortfin mako is targeted by semi-industrial and artisanal fisheries in the Indian Ocean and is caught as bycatch in industrial fisheries, including pelagic longline tuna, swordfish, and purse seine fisheries (IOTC 2015, at 4). An ecological risk assessment conducted for the Indian Ocean assigned shortfin mako as the shark species with the highest vulnerability ranking (No. 1) for longline gear and the third most vulnerable shark species (No. 3) for purse seine gear (IOTC 2017, at 154; Murua et al. 2012).

Reporting is very poor and inconsistent in this region. According to the Indian Ocean Tuna Commission ("IOTC") 2015 assessment for the species, "[i]t appears that significant catches of sharks have gone unrecorded in several countries. Furthermore, many catch records probably underrepresent the actual catches of sharks because they do not account for discards (e.g., do not record catches of sharks for which only the fins are kept or of sharks usually discarded because of their size or condition)" (IOTC 2015, at 4).

The Indian Ocean represented 15% of reported catches (a total of 14,043 t) from 2004–2009, according to FAO data (CoP18 Prop. 42 2019, at). According to the IOTC, the main fleets

operating in the Indian Ocean from 2012–2016 targeting shortfin mako were Spain, South Africa, Portugal, Japan, Iran, and China (IOTC 2017, at 155). Catch data—which are considered an underestimate per the above—in the Indian Ocean in 2016 totaled to 1,631 t (average annual catches of 1,503 t from 2012–2016) (IOTC 2017, at 154). The species has also been reported in catches of longline fisheries targeting tuna and swordfish in Indonesia (CoP18 Prop. 42 2019, at 9 (citing White et al. 2006)) and other areas throughout the region, including India where the species is targeted (CoP18 Prop. 42 2019, at 6–7, 9).

A stock assessment for the shortfin mako shark in the Indian Ocean determined that the stock is subject to overfishing but not overfished (Brunel et al. 2018, at 14). However, trajectories show consistent trends towards the overfished and subject to overfishing status. The assessment recommended reducing fishing mortality levels to levels observed during the 1990s (around 1,570 t, following the lower 95% confidence limit of MSY (Brunel et al. 2018, at 1); note this approximates the annual reported catch, further corroborating that reported catch is a significant underestimate of actual catch (IOTC 2017, at 154–55)). A more robust analysis is planned by the IOTC in 2020.

Given its proximity to Asia, the hub of shark fin markets, the Indian Ocean is likely a primary region for finning.

2. Overutilization for Recreational Purposes

a. Sport Fishing

The shortfin mako is highly valued by big-game recreational fishers and a target of sport fisheries in the United States, New Zealand, and some European countries (CoP18 Prop. 42 2019, at 7). Although many fishers practice catch and release, recreational fishing could also be a threat due to post-release mortality, which is reported at 10% for recreational fishing (Camhi et al. 2008, at 399, 419–20; French et al. 2015, at 2). Elasmobranchii have increased in contribution to total tonnages of recreational fishing globally since the 1990s and today account for 5–6% of total global recreational catches, which average around 900,000 tonnes per year in recent years (Freire et al. 2020, at 12 (5% is equivalent to 45,000 tonnes annually); Figure 33). This impact on shark populations, including the shortfin mako, is poorly documented, however, because fishing reports are considered underestimates and there is no central organization responsible for regularly collecting recreational fishing data in a standardized way (Freire et al. 2020, at 1).

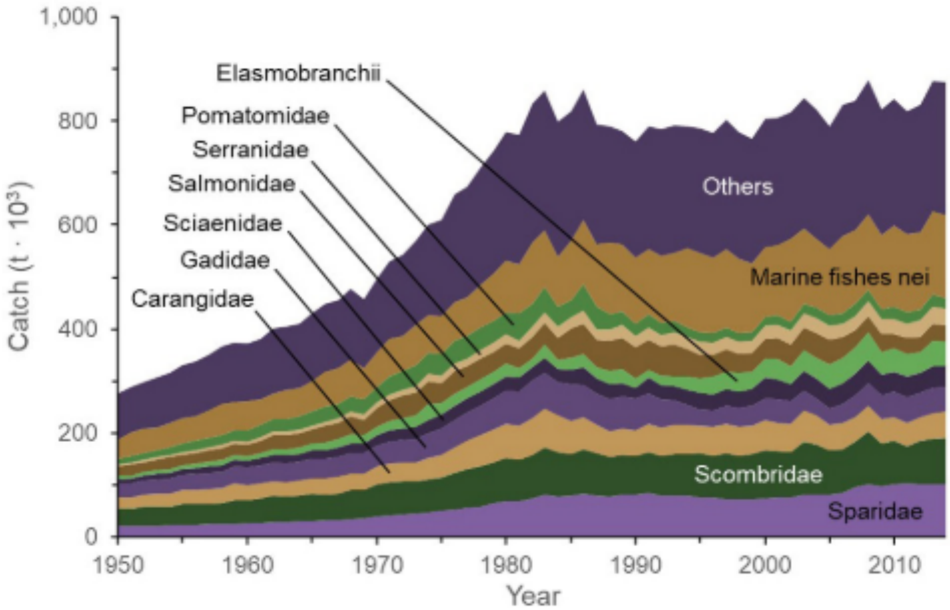

Figure 33. Elasmobranchii (bright green, top left label) make up 5–6% of total global recreational fishing catches annually, or about 45,000 tonnes per year (Freire et al. 2020, at 13).

Below we report what little documentation on sportfishing catch we could access online (*see* Section IV.B.1.a. Sport Fishing). We encourage NMFS to carry out a comprehensive assessment on recreational fishing impacts on shortfin mako. No data were found for the South Atlantic, North Pacific, or Indian Oceans.

i. North Atlantic Ocean

Recreational fishing for sharks on the eastern coast of the United States began off New York and New Jersey in the late 1970s. From early on, the shortfin mako was considered one of the few shark species that was "highly prized for home consumption and often sold to processors to defray the costs of offshore fishing trips" (Casey & Hoey 1985, at 15). In 1978, sport fishermen caught around 17,973 shortfin mako individuals or 2.7 million tonnes (Casey & Hoey 1985, at 18; Table 3).

Area	Number of individuals	Percent of total sharks caught	Weight (lbs/t)
Atlantic north of Virginia	13,292	10.7	2,007,092/910
Atlantic south of Virginia	2,511	4.2	379,161/172
Gulf of Mexico	928	2.0	140,128/64
Total North Atlantic	17,973	7.8	2,695,950/1223

Table 3. Shortfin mako sharks caught by sportsmen across five regions in the western North Atlantic in 1978 (Casey & Hoey 1985, at 18).

Shortfin mako continues to be a prized game fish off the East Coast of the United States (Taylor & Bedford 2001, at 336), and tournaments occur off the northern and mid-Atlantic states (Figure 34).

Catches reported in the United States from 2013–2017 totaled 5,100 individuals, of which 720 were retained annually on average (CoP18 Prop. 42 2019, at 9). Sportfishers contribute significantly to efforts to tag and sample (e.g., at tournaments) shortfin mako for research off both the east and west coasts of the United States (Casey & Kohler 1992, at 49; Heist et al. 1996, at 584; Holts & Bedford 1993, at 902).

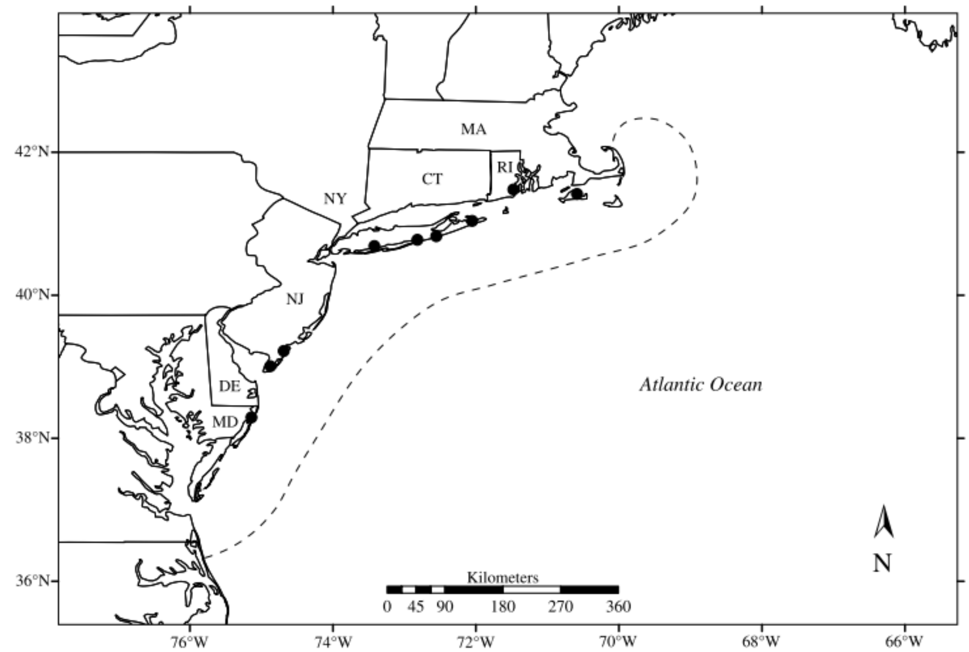

Figure 34. Map of the northeast coast of the United States showing the locations (black dots) of major shark fishing tournaments from May–October of 2001 and 2002 where shortfin mako were sampled for a study (Wood et al. 2009, at 77). Dotted line indicates the approximate boundary where fishing took place for these tournaments.

Sportfishing vessels range in size from small (<9 m) outboard-motor boats for inshore fishing to large (9–18 m) sportfishing cruisers that generally fish between 20 and 50 nautical miles offshore, though trips to 100 nautical miles are not unusual (Casey & Kohler 1992, at 47). Shortfin mako are commonly caught by casting ground or diced fish into the sea (chumming) to attract sharks to the vessel (Casey & Kohler 1992, at 47; Holts & Bedford 1993, at 902).

ii. South Pacific Ocean

Australia permits targeted recreational fishing of the shortfin mako in state and Commonwealth waters. Australian states allow a combined bag limit of one shark, including shortfin mako (Queensland Government webpage 2021 (Queensland, maximum size limit of 1.5 m); Rowling et al. 2010, at 199–202 (New South Wales); Tasmanian Government webpage 2020 (Tasmania); Victorian Fisheries Authority webpage 2021 (Victoria)). Although the shortfin mako is considered an important game species in New South Wales, Tasmania, and Victoria, little data exists on total recreational catch. As of 2010, the New South Wales Government estimates all recreational fishing catch of makos (shortfin and longfin) in its jurisdiction to be 30–140 t annually (Rowling et al. 2010, at 200) (no other data on catch could be found).

Between 1993–2000 in game fishing tournaments in southeast Queensland to southern New South Wales, shortfin mako accounted for 40% of recorded game fishing shark catch, the most frequently caught shark species (Murphy et al. 2002, at 26). Eighty-two percent (82%) of shortfin mako caught in these tournaments were tagged and released. Shortfin mako sharks reportedly often take lures and trolled baits set for billfish and tunas and are often captured using burleying and drifting techniques used more commonly by boats targeting sharks (Murphy et al. 2002, at 26).

3. Beach protection removal

Shortfin mako sharks are netted in some areas of the world as part of beach protection programs implemented for the protection of swimmers and surfers from large sharks. A variety of net types are used, including exclusion nets, mesh nets, and gill nets. Protective gill nets used off Natal, South Africa, killed shortfin mako sharks at an average of 11 sharks per year (range of 3–27 sharks) (Cliff et al. 1990, at 117; Dudley & Simpfendorfer 2006). In eastern Australia in 2018–2019, mesh nets caught 11 mako were caught including 10 dead (NSW Department of Primary Industries 2019, at iii, 25 (note that shortfin mako were shifted to a non-target species in 2017 as part of a new Joint Management Agreement)). Although this threat is not likely a primary cause of population decline, it may compound impacts of more significant threats like bycatch and fishing.

C. Disease or Predation

Predation and parasites can cause mortality of shortfin mako sharks. For example, orcas predate on mako in New Zealand (Visser et al. 2000, at 229–30). In addition, copepods are commonly found on shortfin mako sharks (e.g., over 10 copepod species, and copepods observed on 61 of 63 captured mako (Hashimoto et al. 1995, at 21)). Copepods can cause "severe subacute, necrotizing stomatitis with hemorrhage, granulation tissue and lymphocytic aggregates in the mucosa, and reactive lymphocytic infiltration of the submucosal skeletal muscle," as well as teeth and scale loss, inflammation damaging to nervous tissue, and potential mortality in shortfin mako sharks (Benz et al. 2002, at 25).

However, neither predation nor disease appears to be a primary threat to the species. Most likely these processes may compound existing threats from other major contributing factors, such as predators depredating mako caught by the U.S. Atlantic pelagic longline fishery (0.9% depredated, n = 27 out of 3,085 (MacNeil et al. 2009, at 712)) and parasites infecting mako that are otherwise injured or weakened due to polluted habitat or fishing gear interactions.

D. Inadequacy of Existing Regulatory Mechanisms

The existing regulatory mechanisms, both species-specific and generally-applicable, that are in place to protect the shortfin mako are inadequate. This is because most of these mechanisms "are not yet legally binding, far from comprehensive, lacked clear implementation guidelines, operated with vague wording[,] and lacked compliance monitoring" (Davidson et al. 2016, at 453). This section details existing regulatory protections for the shortfin mako and their inadequacies.

1. United States Regulatory Mechanisms

The United States is characterized by a patchwork of federal and state regulations that protect the shortfin mako to varying degrees. However, these measures are inadequate to protect the species

either within U.S. waters or within the highly migratory species' global range. Moreover, because protection strategies focus on prohibiting retention (e.g., size and catch limits, or gear restrictions) instead of avoiding catch, shortfin mako continue to suffer from post-capture mortality that hinders the effectiveness of these efforts. Further, as discussed above, the international demand for shortfin mako meat and fins has put the species under significant pressure, and the United States lacks any mechanism to prohibit import into, export from, or transshipment through the nation.

a. Shark Finning Bans

Under the authority of the Magnuson-Stevens Fishery Conservation and Management Act ("MSA"), NMFS first banned shark finning by U.S. fishermen in the Atlantic in 1993 through the Fishery Management Plan for Sharks of the Atlantic Ocean. Congress later enacted the Shark Finning Prohibition Act of 2000, which extended the shark finning ban to all U.S. waters. However, the law had a significant legal loophole where U.S. vessels could buy shark fins from foreign ships at sea and bring those unattached fins to the United States for sale. *See generally United States v. Approximately 64,695 Pounds of Shark Fins*, 520 F.3d 976 (9th Cir. 2008). The loophole was later closed by the Shark Conservation Act of 2010, which clarified that all sharks (excluding the smooth dogfish) fished by persons under U.S. jurisdiction must be landed with their fins "naturally" attached and prohibits transferring shark fins from one vessel to another at sea.

While federal law bans finning practices, it does not address the consumption of shark fins. If a shark has been legally harvested and landed, the sale of the fins is allowed so long as there is a "corresponding carcass" (Dulvy et al. 2008, at 474–75). Sharks fins may also be imported from other countries.

As of September 2020, the following 17 states and territories have enacted bans on the sale and possession of shark fins within the boundaries of their respective jurisdictions: American Samoa, California, Delaware, Florida, Guam, Hawaii, Illinois, Maryland, Massachusetts, Nevada, New Jersey, New York, Northern Mariana Islands, Oregon, Rhode Island, Texas, and Washington. NOAA has stated publicly on its website that the state laws of California, Commonwealth of the Northern Mariana Islands, Delaware, Hawaii, Maryland, Massachusetts, New York, Oregon, Washington, and Guam do not conflict with the MSA (NOAA Shark Conservation Act webpage 2019). *See also* Implementation of the Shark Conservation Act of 2010, 81 Fed. Reg. 42,285 (June 29, 2016).

Though these state laws prohibit the sale and possession of shark fins in their jurisdictions, some do not prevent international fins from passing through their ports to other parts of the United States where shark fins remain legal (Figure 35 (citing Murdock & Villanueva 2019)).

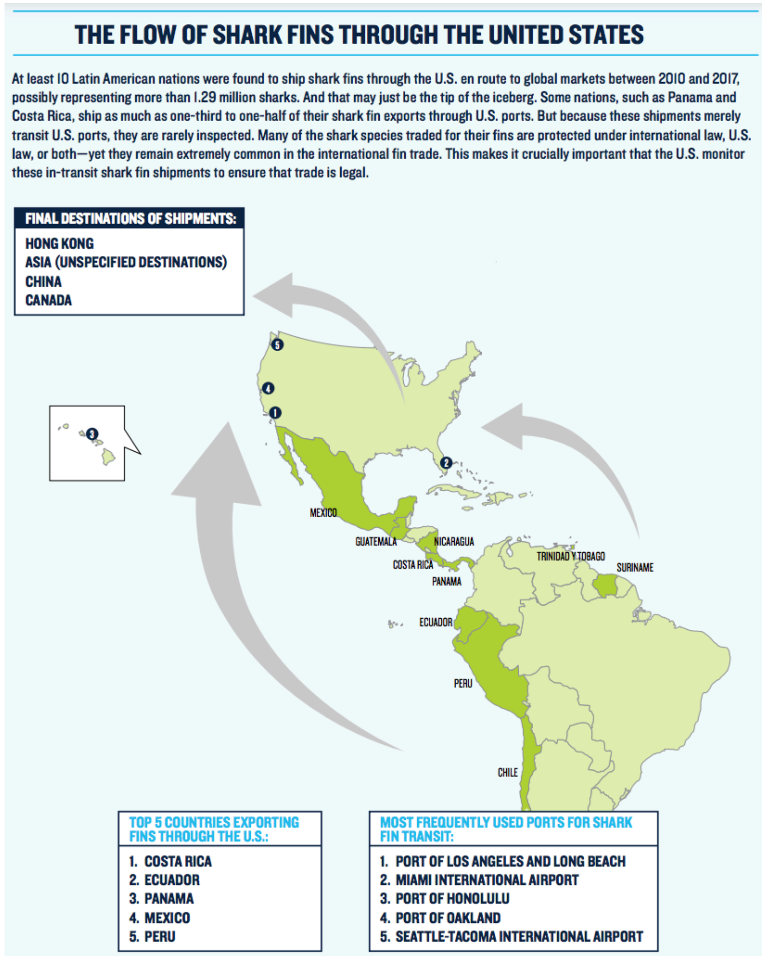

Figure 35. Depicting the shipment of shark fins through the United States between 2010 and 2017 (Murdock & Villanueva 2019, at 10).

The shark fin trade has also adapted to avoid these bans. For example, after several states enacted shark fin bans in 2010, Texas saw a 240% increase in its shark fin trade, causing the state itself to enact a ban that went into effect in 2016 (Herskovitz article 2016). More recently, it has been reported that while first Los Angeles and then Houston served as major transit hubs for shark fins, Florida became a hub as a result of fin trade bans in California and Texas (Murdock & Villanueva 2019, at 11). To combat this problem, Florida recently enacted a ban on the import and export of shark fins on September 17, 2020. Without a federal law, these state laws are insufficient to eliminate commerce in shortfin mako shark fins within the United States and thus reduce incentives to land the species.

In 2019, the Shark Fin Sales Elimination Act (H.R. 737, S. 877) was introduced in Congress, and would make it illegal to possess, buy, sell, or transport shark fins or any product containing shark fins in the United States (with the exception of certain dogfish fins)—effectively banning the U.S. shark fin trade. The House bill received the support of 287 representative cosponsors and was passed on November 20, 2019. The Senate Committee on Commerce, Science, and Transportation has recommended to pass the bill, and it has been put on the Senate legislative calendar for action.

b. Other Federal Regulations

i. Commitment to International Wildlife Conventions

Pursuant to 16 U.S.C. 1531(a), the United States has "pledged itself as a sovereign state in the international community to conserve to the extent practicable the various species of fish or wildlife and plants facing extinction . . . ." Generally relevant to the shortfin mako, this includes the Convention on Nature and Wildlife Preservation in the Western Hemisphere, the International Convention for the Northwest Atlantic Fisheries, the International Convention for the High Seas Fisheries of the North Pacific Ocean, the Convention on International Trade in Endangered Species of Wild Fauna and Flora ("CITES"), and other international agreements (*see also* Section IV.D.3. International Protections (discussing international wildlife conventions). CITES is further implemented by the Lacey Act, 16 U.S.C. §§ 3371–3378, which prohibits trade in wildlife, fish, and plants protected under CITES (16 U.S.C. §§ 1531(a)(4), 1537a; 50 C.F.R. § 23.22). CITES, discussed in Section IV.D.3.c. Convention on International Trade in Endangered Species of Wild Fauna and Flora below, is a treaty aimed at ensuring that cross-border trade does not threaten species' survival. The shortfin mako was protected under Appendix II of CITES in 2019.

While these domestic regulatory mechanisms are important, they have not removed the incentive to take shortfin mako sharks through directed fishing efforts or bycatch retention in order to satisfy market demand.

ii. Magnuson-Stevens Fishery Conservation and Management Act

Under the MSA, NMFS and the respective regional fishery management councils are responsible for the management of the shortfin mako, which the agency segments into the "Atlantic" and "Pacific" shortfin mako populations. The species is managed under the Consolidated Atlantic Highly Migratory Species Fishery Management Plan and the Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species. These plans implement permit requirements, annual commercial harvest quotas and limits, gear restrictions, and species handing and identification workshops.

In early 2019, NMFS amended the Consolidated Atlantic Highly Migratory Species Fishery Management Plan based on recommendations by the International Commission for the Conservation of Atlantic Tunas ("ICCAT") for the North Atlantic shortfin mako. Based on the 2017 ICCAT stock assessment, North Atlantic shortfin mako are overfished and experiencing overfishing. The measures implemented by NMFS under this amendment maximized live releases, reduced the circumstances where retention is allowed, increased the minimum size limits for retention, and worked to improve data collection. Atlantic Highly Migratory Species; Shortfin Mako Shark Management Measures; Final Amendment 11, 84 Fed. Reg. 5358 (Feb. 21, 2019).

Shortly after the management plan measures went into effect, the 2019 Stock Assessment and Fishery Evaluation Report for Atlantic Highly Migratory Species revealed that the Atlantic shortfin mako population was still overfished both internationally and domestically (Atlantic HMS SAFE Report 2019, at 29). In 2019, the U.S. total landed catch of shortfin mako sharks in the North Atlantic was 166 mt which is 7% of the global landed catch (2,388 mt) (Atlantic HMS SAFE Report, 2019, at 95). This is far higher than ICCAT's 2017 recommendation that North Atlantic shortfin

mako shark catches needed to be at or below 1000 mt to prevent further population declines and at or below 500 mt to stop overfishing and begin rebuilding the stock (ICCAT 2017b, at 1), and demonstrates that U.S. regulations are not adequately protecting shortfin mako sharks from fisheries subject to U.S. jurisdiction.

The Atlantic Highly Migratory Species Fishery Management Plan does not implement any quotas specific to the shortfin mako shark. Rather, NMFS groups the shortfin mako with common thresher and oceanic whitetip sharks (which the oceanic whitetip listed as threatened under the ESA) and classifies the three species as "Pelagic Sharks Other Than Porbeagle or Blue." For the 2020 fishing season, NMFS implemented a quota of 488 metric tons for the "Pelagic Sharks Other than Porbeagle or Blue" category and did not implement any regional quotas. Atlantic Highly Migratory Species; 2020 Atlantic Shark Commercial Fishing Year, 84 Fed. Reg. 65,690 (Nov. 29, 2019). Because the Atlantic Highly Migratory Species Fishery Management Plan permits catch at levels far higher than those needed to prevent further declines, stop overfishing, and start rebuilding the North Atlantic stock, and those landings are far higher than ICCAT has determined is compatible with ending overfishing and rebuilding the species, the management plan is inadequate to conserve the species.

As of 2018, the Fishery Management Plan for U.S. West Coast Fisheries for Highly Migratory Species, which governs catch of shortfin mako in waters off Washington, Oregon, and California, still allowed harvest of up to 150 mt of shortfin mako shark despite acknowledging the stock's vulnerability and the possible importance of the U.S. West Coast EEZ as nursery habitat (Pacific Fishery Management Council 2018, at 44).

The Pacific shortfin mako populations in the state and territorial waters of Hawaii and the U.S. Pacific Islands are managed by the Western Pacific Regional Fishery Management Council in collaboration with NMFS. The Council currently has five place-based fishery ecosystem plans (one each for the Hawaii, American Samoa, and Mariana (Guam and the Commonwealth of the Northern Mariana Islands) Archipelagos; one for the U.S. Pacific Remote Island Areas; and another for the Pacific Pelagic fisheries) (codified in 2010) (WPRFMC webpage 2021). The approach of these management plans allows explicit consideration to be given to the ecosystem interactions within each of the areas managed by the Council. They specifically regulate the number of vessels that can enter the fishery, the type of fishing allowed, and additional permits and required equipment. However, while the shortfin mako shark is technically a managed species under the regional plan, there are no management measures specifically protecting the species. Therefore, this plan is inadequate to conserve the species.

iii. Marine Protected Areas

The United States has established numerous marine protected areas, including national marine sanctuaries (designated under the National Marine Sanctuaries Act, 16 U.SC. § 1421 *et seq*.) and five marine national monuments (established under the Antiquities Act, 54 U.S.C. §§ 320301–320303), federally designated areas within U.S. waters where the marine environment is given varying degrees of protection. National marine sanctuaries are managed by NOAA in partnership with state governments, whereas the marine national monuments are generally managed by a collection of federal and state agencies, including NOAA and FWS. While both sanctuaries and monuments can provide much-needed protections for marine wildlife and habitat, these protections do not necessarily prohibit fishing. Commercial fishing is prohibited in all four Pacific marine national

monuments. However, on June 5, 2020, by presidential proclamation, the Northeast Canyons and Seamounts Marine National Monument was reopened to commercial fishing. Proclamation No. 10,049, 85 Fed. Reg. 35,793 (June 5, 2020). This is the only U.S. marine national monument in the Atlantic Ocean. The shortfin mako tends to aggregate around seamounts, with probability of catch increasing closer to those features (Morato et al. 2010, at 9707). Unless these protections are restored, commercial fishing in the Monument may further negatively affect shortfin mako abundance in the North Atlantic.

c. State Regulations

Apart from shark finning bans, discussed above, states and territories have not implemented additional regulations to protect the shortfin mako. The shark is primarily taken as bycatch in commercial fisheries; however, it is also a target species for sport fishing in the Atlantic and Pacific, including state and territorial waters (CoP18 Prop. 42 2019, at 7–8 (citing CMS 2008; Bustamante & Bennett 2013; Campana et al. 2005; Francis et al. 2001; Petersen et al. 2009)). While there are size restrictions and catch limits in some states and territories, these merely comply with federal regulations for ease of enforcement and are not aimed at enlarging protections for this vulnerable shark species (*see, e.g.,* Florida Harvestable Sharks webpage 2021). These state regulations are inadequate to conserve the species.

2. National Protections in Other Range States

While there are varied national and regional measures in place to protect the shortfin mako and sharks in general, none of the current measures are adequate to conserve the species.

Various national regulatory mechanisms exist to protect the shortfin mako, or at least sharks in general (CoP18 Prop. 42 2019, at 10–11). Some countries specifically limit shortfin mako landings, while numerous range states, discussed below, have implemented full or partial bans on shark fishing, finning, and trade. Additionally, range states have created marine protected areas and shark sanctuaries in an effort to create safe havens for marine species, including the shortfin mako (TRAFFIC 2019, at 3). While these conservation efforts are laudable, most measures would benefit from enhanced monitoring.

The international acknowledgment of these shortcomings has resulted in some countries expanding their protections. For example, acting on recommendations made by ICCAT scientists, Canada recently became the first North Atlantic country to ban the retention of shortfin mako, dead or alive, in its Atlantic fisheries beginning in the 2020/2021 season (Whorley 2020, at 1). The Department of Fisheries and Oceans issued a release that stated the "decision has been informed by views of [Atlantic Large Pelagics Advisory Committee] members as well as the most recent science available for this species" (Whorley 2020, at 1). Prior to this decision, Canada ranked fifth among ICCAT Parties for shortfin mako landings, despite having regulations in place to keep landings bellow 100 t per year as part of its precautionary approach (CoP18 Prop. 42 2019, at 10). Similarly, the British territory of Gibraltar listed the shortfin mako in Schedule 1 of the Nature Protection Act of 1991, so there is no trade of the species (however implementation of this is unclear) (CoP18 Prop. 42 2019, at 10).

Many other countries have implemented measures to protect the shortfin mako, although the degree of protection varies. Such measures include: bycatch and recreational bag limits in South Africa;

management under a quota management system in New Zealand; gear regulations for artisanal fisheries in Chile; gear restrictions, and fishing refuges and protected coastal and marine areas covering 22.3% of the marine areas in Mexico (CoP18 Prop. 42 2019, at 12–13 (citing CMS 2008)). In addition, a review of the implementation of the FAO International Plan of Action for the Conservation and Management of Sharks, which focused on the 26 main shark fishing countries, areas and territories, reported that 88% of the countries had at least a draft national plan of action for sharks and 57% had adopted measures concerning shark finning (CoP18 Prop. 42 2019, at 12 (citing Fischer et al. 2012)). In addition, there are several Regional Plans of Action for the Conservation and Management of Sharks (CoP18 Prop. 42 2019, at 12 (citing Fischer et al. 2012)).

a. Shark Finning Bans

At least 30 countries (including the United States, discussed above), the European Union, the Organización del Sector Pesquero y Acuícola del Istmo Centroamericano ("OSPESCA"), and several Regional Fisheries Management Organizations ("RFMOs"), including ICCAT in 2004, the IOTC in 2005, the IATTC in 2005, the Commission for the Conservation of Southern Bluefin Tuna in 2008, and the WCPFC in 2010, have implemented full or partial bans on shark finning (Animal Welfare Institute webpage 2021; Dulvy et al. 2008, at 474). An additional 22 countries and jurisdictions have implemented full or partial bans on shark fishing, such that shark finning is also banned (Animal Welfare Institute webpage 2021). However, the strict enforcement that is necessary for these measures to be effective is often lacking, thus hindering the efficacy of these bans (Camhi et al. 2007, at 34–35; Dulvy et al. 2008, at 474).

Also, where RFMOs or international or regional agreements are concerned, implementation of the bans is often not mandatory or enforceable, leading to continued finning even where a ban is in place. For example, the WCPFC ban allows coastal states to apply alternative measures to the fin ban in their national waters, thus allowing them to circumvent the ban in the waters that are most subject to observer coverage (Clarke et al. 2013, at 10). This loophole may be part of the reason that "[a]s of October 2010, of the 32 WCPFC members only half had confirmed they were fully implementing the finning prohibition. Only 11 provided specific confirmation of [any ban implementation], and few of these reported the degree of compliance" (Clarke et al. 2013, at 10). As a result, "although some reduction in the proportion of sharks finned appears to have occurred in the [WCPFC] purse-seine fishery, there is little evidence that the proportion of sharks finned in the longline fishery has been reduced since the WCPFC measure was adopted" (Clarke et al. 2013, at 10).

Most countries and RFMOs use fin-to-carcass weight ratios as a means to ensure compliance with finning bans, which are difficult and costly to enforce, and vary between fleets (Clarke et al. 2013, at 2 (assessing the weaknesses in one such RFMO fin ratio); Dulvy et al. 2008, at 474). In addition to these difficulties, the upper end of the ratio creates loopholes that "potentially enable fishermen to fin sharks without exceeding the ratio limit" (Dulvy et al. 2008, at 474). Though this particular loophole has been closed in the United States with the passage of the Shark Conservation Act of 2010 and the abolishment of the fin-to-carcass ratio in favor of a policy requiring that sharks are landed with their fins attached, statements from NOAA's Office of Law Enforcement are useful in showing the difficulty that fin-to-carcass ratios pose to enforcement personnel in the many jurisdictions where they still exist. Citing Special Agent Paul Raymond of NOAA's Office of Law Enforcement, Abercrombie et al. noted that, "[a]lthough shark finning . . . is illegal in U.S. waters, it is suspected that some fishermen may be finning incidentally caught [sharks with high value fins]

and keeping just their fins for their high value, while retaining carcasses from different shark species with higher value flesh but lower value fins" (Abercrombie et al. 2005 at 786 (citing personal comments from Special Agent Paul Raymond of NOAA's Office of Law enforcement)). By retaining high-value fins from shortfin makos and high-value carcasses for meat from other sharks, fishermen are able to continue finning while maximizing profits and avoiding fin bans. Therefore, even where these finning bans exist, there are often opportunities to avoid their regulation and/or to harvest shortfin makos in unsustainable numbers to satisfy market demands.

Additionally, finning bans only "prohibit the retention of shark fins on board vessels without the corresponding carcasses" and do not prohibit landing the entire shark and finning it once it is on land (Dulvy et al. 2008, at 474, 475). As a result, even assuming perfect enforcement, finning bans cannot halt overfishing of sharks that happens where the carcasses are landed before being finned (Clarke et al. 2012, at 198; Dulvy et al. 2008, at 474). Finning bans are thus unable to remove the incentive to take these species through directed fishing efforts and through bycatch retention in order to satisfy the market demand for their resultant products.

Furthermore, while retention-based weaknesses of finning bans are important to note, even where bycaught individuals are released and not finned or otherwise retained, many shortfin makos will still die as a result of being caught (*see* Section IV.B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes (discussing likely high primary post-capture mortality and post-release mortality of shortfin makos)). As a result, shortfin makos will often die as a result of capture, even where they are not retained. Therefore, initial capture, and not only retention, must also be avoided.

Finally, these bans only help to avoid overutilization threats and do nothing to address the other threats that the shortfin mako faces. While such bans do reduce market demand for shark fins, they primarily address issues of cruelty and waste and are not a sufficient mechanism on their own to protect shark species, like the shortfin mako, that are facing a variety of exceptionally serious threats.

b. Shark Sanctuaries

In response to the rapid decline of numerous shark populations, a number of jurisdictions have created what are called "shark sanctuaries" (Figure 36). These areas, while they vary in detail, generally prohibit targeted commercial fishing of sharks (i.e., either sharks in a strict sense or both sharks and rays), retention of sharks caught as bycatch, and the possession, trade, and sale of sharks and shark products within entire EEZs (Pew Charitable Trusts 2018, at 1). "Some also ban fishing gear typically used to target sharks, such as wire leaders and shark lines" (Pew Charitable Trusts 2018, at 1).

Currently, there are a total of 17 shark sanctuaries around the world collectively spanning more than 7.5 million square miles (Pew Charitable Trusts 2018, at 1). Palau designated the first of these sanctuaries in its national waters in 2009. More recently, in 2015, several nations and territories in the western Pacific Ocean joined efforts to create the first regional sanctuary in Micronesia.

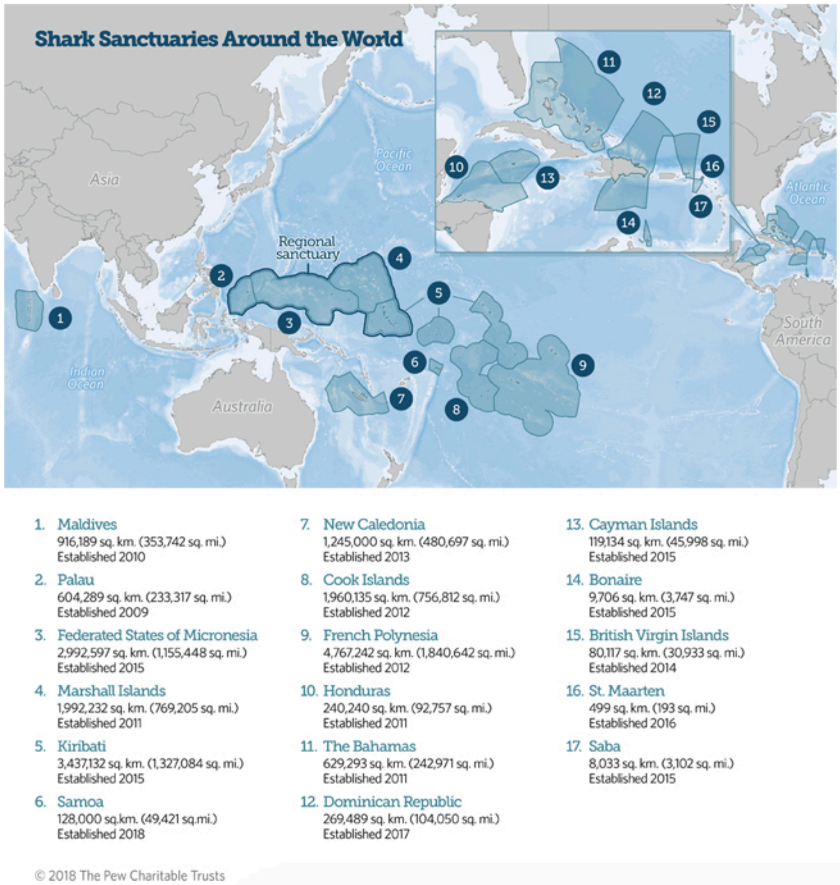

Figure 36. Depicting shark sanctuaries around the world (Pew Charitable Trusts 2018, at 2).

While these sanctuaries are an important step towards the greater conservation of many shark species, the protections are only enforceable within their bounds. Thus, for highly migratory species with extensive geographic ranges, such as the shortfin mako, these protections do little for the overall conservation of the species.

c. Marine Protected Areas

Around the world, marine protected areas ("MPAs") also offer varying levels of protection to sharks. While these MPAs are vital to marine biodiversity conservation, they cannot provide sufficient regulatory protections for overexploited and highly migratory species. MPAs may offer some protection when adequately enforced, but such localized protections can indirectly cause harm to species if impacts to biodiversity are merely displaced (Baum et al. 2003, at 391). For instance, fishing efforts may be redistributed to other regions that do not have the same protections, which is especially problematic for highly migratory species like the shortfin mako (Breen et al. 2015, at 80).

The level of protection in MPAs varies from nearly complete no-entry zones to areas of only partial protection (e.g., MPAs that focus only on benthic species or only limiting one type of fishing gear or activity) (Devillers et al. 2015, at 481). Currently only a small percentage of MPAs are no-take zones, estimated to cover only 0.1% of the world's oceans. The majority still allow some degree of exploitation (Devillers et al. 2015, at 486). As a result, "MPA effectiveness can be variable, depending on the objectives of management, appropriateness of zoning, and levels of compliance,

and marine ecosystem types are very unevenly represented within MPAs" (Devillers et al. 2015, at 481 (citation omitted)). If take is possible in an MPA, it does little to protect shortfin mako sharks present there.

Additionally, MPAs have been largely restricted to national waters, mostly covering continental shelves and equivalent areas (Devillers et al. 2014, at 481). In fact, only 0.17% of MPAs are on the high seas where other protections for the shortfin mako are lacking (Devillers et al. 2015, at 486). There has been a recent trend in creating large, remote MPAs, but even these new, large MPAs are unlikely to have significant effect on fishing pressure for shortfin makos because they are generally designed to avoid impacting extractive uses of the oceans (Devillers et al. 2015, at 491). Marine reserves are residual where their location intentionally mirrors areas that are least appealing for extractive uses, including fishing (Devillers et al. 2015 at 495). "Residual reservation arises from an implicit or explicit policy of locating MPAs to minimize the opportunity costs to those people engaged in extractive uses of the land and sea, even though many of the important threats to . . . marine biodiversity arise from those extractive uses" (Devillers et al. 2015, at 483 (citation omitted)). This risks the perverse outcome that "protection avoids the more heavily used and costly areas (in financial and/or political terms) and is not afforded to biodiversity most in need of protection" (Devillers et al. 2015, at 484 (citation omitted)). Current large MPAs show a clear bias towards protecting areas that are already subjected to below-average fishing pressure (Devillers et al. 2015, at 490). Thus, they will have little effect on catch, even if it is possible to somehow police restrictions in these massive areas of the ocean (Devillers et al. 2015, at 495 ("Too often, the establishment of protected areas is seen as equivalent to effective protection, and very often this conflation of ideas is mistaken. Protected areas fail in their basic purpose to the extent that they are residual to extractive uses. A strong focus on minimizing the opportunity costs of MPAs, combined with limited biological data and highly generalized conservation objectives, entails the considerable risk of pushing 'protection' into residual parts of the ocean.")).

For highly migratory species like the shortfin mako, it is especially problematic when MPAs are small or widely spread out. Studies have indicated that "rather than the overlap between occupied area and the MPA, it is the time spent inside an MPA that is an important factor for the success of [highly migratory fish species]" (Breen et al. 2015, at 78 (citation omitted)). Therefore, unless the MPA covers a place where the species is stationary for a period of time (e.g., by protecting spawning grounds, nursery areas, or aggregation sites), then it may offer comparatively little protection to species that will otherwise pass through the area quickly (Breen et al. 2015, at 78). Connectivity of MPAs is also important for highly migratory species, and the haphazard manner by which many MPAs are designed does not reliably facilitate this value (Breen et al. 2015, at 78). Therefore, most MPAs will be ineffective at protecting shortfin mako sharks over the long term.

It does not appear that presently-protected areas are designed to protect the shortfin mako specifically, and, to the extent that they do not cover the species' range, may actually cause additional harm by redirecting fishing pressure into the species' habitat or by assuaging concerns over threats to the species (Breen et al. 2015, at 76 ("[W]hile there are a large number of MPAs aimed at protecting benthic habitats and site attached fish species, there are very few examples of MPAs designed to protect [highly migratory fish species]." (citation omitted))). This fact and the complications outlined above illustrate that MPAs as currently designated are inadequate to conserve the shortfin mako.

3. International Protections

Increasing pressure from fisheries worldwide, coupled with the high value of the shortfin mako's meat and fins and the species' vulnerable life history, have resulted in significant declines in shortfin mako populations over the last few decades. The species is now listed on Annex I of the United Nations Convention on the Law of the Sea, Annex I of the Convention on the Conservation of Migratory Species of Wild Animals' Migratory Shark Memorandum of Understanding and Appendix II of the Convention on Migratory Species, Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora, Annex II of the Barcelona Convention, and Appendix II of the Bern Convention (*see generally* Section II.F. Best Available Scientific and Commercial Data (citing 50 C.F.R. § 424.11(f))). The success of conservation measures agreed upon through international wildlife and fisheries treaties depends upon implementation at the domestic level. But for sharks, and specifically the shortfin mako, such implementation is seriously lacking (Rigby et al. 2019, at 6).

a. United Nations Convention on the Law of the Sea

The shortfin mako is listed under Annex I, Highly Migratory Species, of the United Nations Convention on the Law of the Sea ("UNCLOS") (UNCLOS Annex I webpage 2021), which indicates that it is necessary for states to cooperate directly or through appropriate international organizations to take measures for the conservation of the species (CoP18 Prop. 42 2019, at 11) (listed as part of the *Isurida* family, an old name for the *Lamnidae* family). However, little progress has been made in this regard. Therefore, the species does not receive any tangible protection under UNCLOS. Furthermore, even if management were in place, the United States has not ratified the treaty.

b. Convention on Migratory Species

The shortfin mako is listed on Appendix II of the Convention on the Conservation of Migratory Species of Wild Animals, also known as the Convention on Migratory Species ("CMS") or the Bonn Convention, which aims to conserve species within their migratory ranges through regional efforts by Parties (Rigby et al. 2019, at 6 (listed in 2008)). The species is also covered under Annex I of the CMS Memorandum of Understanding for Migratory Sharks ("MOU"), which specifically aims to achieve and maintain a favorable conservation status for migratory sharks throughout their range (Rigby et al. 2019, at 6). While the United States is a non-party to CMS, it is a signatory to the MOU (CMS Parties and Range States webpage 2021). The MOU recommends that conservation measures for mako sharks (both shortfin mako and longfin mako) be incorporated into national legislation of all Parties and Signatories to CMS (CMS MOS3 2018, at 3). Further, the MOU for makos recommends improvement of the understanding of mako sharks through strategic research, monitoring, and information exchange; improvement of multilateral cooperation among regional fishery bodies and organizations, and at international and regional fora; identification of effective approaches to reduce bycatch and improve survivorship of mako sharks; and raising awareness about threats to mako sharks (CMS MOS3 2018, at 3–4).

While the CMS and MOU provisions encourage parties to take conservation actions, the provisions are not binding. Despite being listed on Appendix II since 2008, overfishing and unregulated landings of shortfin makos continue to endanger the species. Therefore, without specific actions by

parties and signatories to conserve the species, the CMS listing and MOU for Migratory Sharks are inadequate to protect the shortfin mako.

c. Convention on International Trade in Endangered Species of Wild Fauna and Flora

In 2019, at the Convention on International Trade in Endangered Species of Wild Fauna and Flora ("CITES") 18th Conference of the Parties, two-thirds of the 183 CITES parties agreed to list the shortfin mako (and the longfin mako as a "look-alike" species) under Appendix II of the convention (*see* Section II.H. Similarity of Appearance Determinations; Section VII. Similarity of Appearance Determination). Although the United States has supported the listing of other less commercially valuable shark species under CITES in the past, it did not join numerous other parties in support of Mexico's proposal to list the shortfin mako and ultimately voted against the listing (Fobar article 2019). Other opposing parties include Japan, Iceland, Malaysia, China, and New Zealand. Although the Appendix II listing is certainly of benefit, the listing offers insufficient protection to the shortfin mako as it still allows trade in the species and does not protect it from other threats.

An Appendix II listing is not a trade ban. It merely serves as a regulation on the trade of the species that does occur. The Appendix II listing only requires that exporting countries provide a permit that states the exported shortfin mako carcasses, fins, or other parts came from sustainably harvested populations. This is problematic because there is currently no clear standard for these so-called "non-detriment findings," which are used to determine whether killings of covered species would threaten sustainable populations. Even if there were some way to determine what a sustainable population means, it would be difficult to demonstrate a sustainable shortfin mako population because of the limited population assessments for the species throughout most of its range (FAO 2019, at 17; *see generally* Section III.G. Population Trend; Section IV.B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes). If properly implemented, a "CITES Appendix II listing would be expected to result in better monitoring and reporting of catches entering international trade from shortfin mako shark populations" (FAO 2019, at 17). However, development of a non-detriment finding requires appropriate scientific capacity, biological information on the species, and a framework for demonstrating that exports are based on sustainable harvests.

> [S]tates' abilities to make NDFs for highly migratory species is limited in the absence of region-wide assessments, as evidenced by difficulties encountered in making NDFs for shark species that have already been listed. Under these conditions the following outcomes can occur: previous trade ceases, trade continues without proper CITES documentation (i.e. illegal trade) and/or trade continues with inadequate NDFs.

(FAO 2019, at 17). Due to the lack of adequate scientific capacity in many CITES member countries, the lack of adequate population and other biological information relating to the shortfin mako, and the lack of a standardized frameworks for making non-detriment findings, these determinations will necessarily be inconsistent and unreliable.

In addition, there are several loopholes that can be used to avoid adequately protecting CITES-listed species, particularly when there is an illegal market for those species. Part of the problem is that Appendix II only requires a permit for exports of species listed therein. Therefore, it does not require a country to demonstrate that domestically-consumed shortfin makos that were caught in its

waters came from sustainable populations. Furthermore, the fact that only an export permit, and not an import permit, is required for international trade means there is one less level of scrutiny that those wishing to smuggle shortfin mako products internationally must meet. Thus, fishermen from one country could kill shortfin makos in international waters and take them directly to any importing country. If they were to do so without returning to their country of origin they could completely avoid any permitting procedure under Appendix II of CITES. Because many countries catch shortfin makos in international waters, this loophole may have serious impacts on the species. Furthermore, in addition to countries that are not parties to CITES, and are therefore not bound by its restrictions, at least 12 CITES parties, including Indonesia (the world's number one shark catching nation (Okes & Sant 2019, at 3)) and Japan (world's number 14 shark catching nation (Okes & Sant 2019, at 3)), entered reservations to the shortfin mako's listing and thereby exempted themselves from even the limited requirements contained therein (CITES Reservations 2019, at 1).

Therefore, the CITES listing is an inadequate regulatory mechanism for protection of the shortfin mako.

d. Regional Fisheries Management Organizations

Many shark species, including the shortfin mako, migrate out of national jurisdictions into the high seas (areas beyond national jurisdiction), making international cooperation essential to effective shark conservation. International fisheries management is the responsibility of a network of regional fishery management organizations ("RFMOs"), tasked with collecting fisheries statistics, assessing resources, making management decisions, and monitoring activities (FAO webpage 2016). "However, management is often complicated by deficient or unavailable data and inadequate systems of administration[,] [a]nd challenges exist in enforcing conservation and management measures adopted by regional fisheries organizations." (FAO webpage 2016). Further, there are areas, including in the Arctic, Central Atlantic, and Southwest Atlantic, where no RFMOs currently exist, creating a host of governance problems (FAO webpage 2016; Figure 37).

Figure 37. RFMOs as recognized by the FAO (IUCN SSC webpage 2021).

"In general . . . international fisheries managers continue to view sharks as bycatch rather than target species requiring management, despite the fact that the high value of shark fins is widely acknowledged as a major driver of shark mortality" (Clarke et al. 2013, at 2 (citations omitted)). This

has meant that RFMO's have traditionally provided little protection for shark species, as illustrated by the lack of catch limits for the shortfin mako, and that these protections have generally been inadequate where they do exist (Rigby et al. 2019, at 6).

Recently, however, tuna RFMOs have adopted measures that prohibit shark finning, encourage the live release of sharks (in non-targeting fisheries), and require collection and submission of data for shark species (FAO 2019, at 13). "Management measures for shortfin mako sharks specifically, which include requirements for live release if possible, have been adopted by ICCAT in the North Atlantic as that stock is currently declining as a result of excessive fishing mortality" (FAO 2019, at 13; Rigby et al. 2019, 6 (adopting the measure in response to scientific advice to ban retention of overfished North Atlantic shortfin makos)). Further, in 2012, the General Fisheries Commission for the Mediterranean ("GFCM") banned retention and mandated careful release for the shortfin mako and 23 other elasmobranch species listed on the Barcelona Convention Annex II. However, implementation by Parties has been very slow (Rigby et al. 2019, at 6). The European Union has more successfully implemented this measure through domestic regulations but has yet to limit shortfin mako catch from anywhere else, including Spain, consistently the world's top shortfin mako fishing nation (Rigby et al. 2019, at 6).

There are five tuna RFMOs, which manage tuna and highly migratory tuna-like species, including the shortfin mako—the Commission for the Conservation of Southern Bluefin Tuna ("CCSBT"), Inter-American Tropical Tuna Commission ("IATTC"), International Commission for the Conservation of Atlantic Tunas ("ICCAT"), Indian Ocean Tuna Commission ("IOTC"), and Western and Central Pacific Fisheries Commission ("WCPFC"). Member nations of these governing bodies are responsible for setting catch limits, monitoring the health of stocks, and regulating the right to fish. Further, RFMOs set measures as recommendations or resolutions that Contracting Parties must implement and report on (CoP18 Prop. 42 2019, at 12 (citing Tolotti et al. 2015)). Most RFMOs have adopted bans on shark finning and require that vessels do not have fins on board that total more than 5% of the weight of sharks on board until the first point of landing (CoP18 Prop. 42 2019, at 12 (citing Marshall & Barone, 2016); NOAA Pacific Shortfin Mako Shark Overview webpage 2021 ("There are no international measures in place specific to shortfin makos, but both the IATTC and WCPFC have passed shark conservation and management measures that combat shark finning practices and encourage further research and periodic stock assessment efforts for sharks.")). However, given the declining global status of shark populations, several RFMOs recommend that their Parties improve data collection, ban shark finning, and conduct population and risk assessments (CoP18 Prop. 42 2019, at 11).

Specific measures that tuna RFMOs have implemented include the following. CCSBT encourages both members and cooperating non-members to comply with a variety of binding and non-binding measures to protect species ecologically related to the Southern bluefin tuna, including sharks such as the shortfin mako (CMS MOS3 2018, at 4). IATTC has passed resolutions to improve the collection and analysis of data on fish-aggregating devices ("FADs") and the conservation of sharks caught in association with fisheries in the eastern Pacific Ocean (CMS MOS3 2018, at 4 (citing Res. C-16-01)). IOTC has also passed several resolutions to improve the scientific and management framework on the conservation of shark species caught in association with IOTC fisheries, as well as a prohibition on the use of large-scale driftnets and a FADs management plan, which includes limitation on the number of FADs, more detailed specifications of catch reporting from FAD sets, and development of improved designs to reduce incidence of entanglement of non-target species (CMS MOS3 2018, at 5 (citing Res. 13/06; Res. 15/09; Res. 17/05; Res. 17/07; Res. 17/08)).

WCPFC has also implemented conservation and management measures to prohibit the use of large sale driftnets, improve management measures for sharks, and manage the application of high seas FAD closure and catch retention (CMS-MOS3 2018, at 5 (citing CMM2008-04; CMM 2014-05; CMM 2010-07)). While none of these measures are specific only to the shortfin mako, they do prioritize conservation and data collection for the species.

Given the current status of shortfin mako populations in the Atlantic, however, ICCAT has been the most active RFMO with respect to management and conservation of the species. Several Ecological Risk Assessments commissioned by ICCAT have ranked both the shortfin mako and longfin mako as highly vulnerable within ICCAT fisheries (TRAFFIC 2019, at 3). In 2017, scientists advised ICCAT to ban retention of overfished North Atlantic shortfin makos, but the Parties only passed a measure aimed to maximize live release by narrowing the conditions under which shortfin makos can be landed (TRAFFIC 2019, at 3 (referencing ICCAT Rec. 17/08)). Landings in 2018, however, remained above the overfishing threshold (TRAFFIC 2019, at 3).

In 2019, ICCAT scientists reported that the North Atlantic shortfin mako population is subject to continued overfishing, and will decline for at least the next 15 years, requiring substantial reductions in fishing mortality to begin rebuilding (TRAFFIC 2019, at 3). Under the current ICCAT measures, the population is predicted not to recover by 2070 (TRAFFIC 2019, at 3). ICCAT scientists calculated that North Atlantic catches (including discards) need to be cut to zero to have a 53% chance of rebuilding by 2045 (TRAFFIC 2019, at 3). Despite this information, the United States opposed the 2019 proposal from ten other Parties to heed the scientific advice. While recommendations are made and measures adopted annually, ICCAT has taken no concrete steps to safeguard South Atlantic shortfin makos at this time (TRAFFIC 2019, at 3). The current ICCAT review process has been partially delayed due to the COVID-19 pandemic and the 2020 annual Commission meeting has been cancelled. Panel 4 of ICCAT (which addresses "other species") recently reviewed separate proposals from the European Union (PA4_804), United States (PA4_805), and Canada (PA4_806) regarding the North Atlantic shortfin mako shark but could not reach a consensus on the recommendations causing decisions regarding the species to be postponed until May 2021. This postponement is a recent and clear example of the inadequacy of the RFMOs as existing regulatory mechanisms.

e. Other International Protections

"On a regional level, the shortfin mako is protected by Annex II (list of endangered or threatened species) of the Barcelona Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean and is included in Appendix III (protected fauna species) of the Bern Convention on the conservation of European wildlife and natural habitats in the Mediterranean (Council of Europe, 2002); yet, it is not included in the EU Habitats Directive (Council Directive 92/43 / EEC of 21 May 1992)" (CoP18 Prop. 42 2019, at 12). Inclusion in the Barcelona Convention means that the shortfin mako cannot be retained on board, transshipped, landed, transferred, stored, sold, displayed or offered for sale and must be released without harm to the extent possible (CoP18 Prop. 42 2019, at 12).

E. Other Natural or Manmade Factors Affecting Continued Existence

1. Climate Change

The shortfin mako will experience or is already experiencing both direct and indirect effects of climate change. The proposal to list the shortfin mako under CITES Appendix II specifically identified climate change as a threat to the species:

> [G]iven that temperature is an important environmental factor for the spatial and temporal distribution of the shortfin mako, the use and habitat distribution of the species will probably be affected by the warming of oceanic waters as a result of climate change.

(CoP18 Prop. 42 2019, at 8 (citing Vaudo et al. 2016)). Warming waters will not only shift the habitat and location of the shortfin mako but also its prey, likely altering the hunting behavior of the shark (Robinson et al. 2015; *see also* Senina et al. 2018 (under the IPCC's "business as usual" emissions scenario, modeling indicates significant changes in distribution of tuna species as a result of climate change)). In addition, warming oceans are leading to an increase in the bioaccumulation of the harmful neurotoxicant methylmercury in prey species such as cod, tuna, and swordfish (Schartup et al. 2019). Recent studies have also found that as the oceans warm and become more acidic as a result of carbon absorption, the survival of embryos and newly hatched sharks rapidly decline (Rosa et al. 2014). Sharks exposed to higher carbon dioxide levels also experienced physiological changes that affect their sense of smell and hunting ability (Dixson et al. 2014). These are just some examples of the known and predicted impacts of climate change on the shortfin mako and other pelagic shark species—but it should be noted that climate change may affect the shortfin mako in many yet to be known ways (Climate Central article 2015 (quoting Dr. Samuel Gruber, hark biologist and founder and director of the Bimini Shark Lab, "Sharks' reaction to the climate is often hard to see, according to Dr. Gruber. The effects of climate change are 'swamped by the overfishing, pollution and anthropogenic damage to shark populations[.]'")).

The United Nations Intergovernmental Panel on Climate Change's special report on global warming demonstrated that we are already seeing the consequences of 1°C of global warming above pre-industrial levels (IPCC 2018). Such consequences include more extreme weather, warming seas, diminishing Arctic sea ice, rising sea levels, coral reef decline, and other changes (IPCC 2018, at 7–10). Continued warming of 1.5°C or higher will cause long-lasting or irreversible changes to natural habitat and ecosystems (IPCC 2018, at 5). Limiting global warming would require a rapid and significant decline in human-caused greenhouse gas emissions as well as the removal of carbon dioxide from the air (i.e., carbon capture and storage) (IPCC 2018, at 15). While some nations are taking actions to reduce emissions, there is no imminent solution to global climate change or the negative effects of global warming on the shortfin mako. Climate change represents a significant manmade threat to ocean habitat and species that will increase the likelihood of the shortfin mako shark's extinction.

2. Synergistic Effects

The synergistic effects of the threats discussed above could cause the extinction of the shortfin mako. "Like interactions within species assemblages, synergies among stressors form self-reinforcing mechanisms that hasten the dynamics of extinction" (Brook et al. 2008, at 457). The shortfin mako

is already at risk as a low-fecundity species, rendering it more vulnerable to synergistic impacts of threats.

> Traits such as ecological specialisation and low population density act synergistically to elevate extinction risk above that expected from their additive contributions, because rarity itself imparts higher risk and specialisation reduces the capacity of a species to adapt to habitat loss by shifting range or changing diet. Similarly, interactions between environmental factors and intrinsic characteristics make large-bodied, long-generation and low-fecundity species particularly predisposed to anthropogenic threats given their lower replacement rates.

(Brook et al. 2008, at 455 (internal citations omitted)). Therefore, although some stressors in isolation may not, on their own, significantly increase the extinction pressure that these species face, the synergistic impacts of multiple threats to the shortfin mako likely increase the extinction pressure that it faces.

V. CRITICAL HABITAT DESIGNATION

This Petition requests that NMFS designate critical habitat for the shortfin mako in U.S. waters concurrently with a final ESA listing pursuant to 16 U.S.C. § 1533(b)(6)(C). The definitions of the terms "critical habitat" and "conservation" indicate that, in designating critical habitat, NMFS must consider these species' ultimate recovery, and not just survival, as a primary purpose of critical habitat designation. *See* 16 U.S.C. § 1532(5)(A) (defining critical habitat to include both occupied and unoccupied habitat that is "essential for the conservation of the species"); 16 U.S.C. § 1532(3) (defining "conservation" as "the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this chapter are longer necessary"). Accordingly, the critical habitat designation for the shortfin mako should include all the areas currently or potentially inhabited by the species, and a sufficient amount of other potentially suitable habitat in U.S. waters, to allow the species to recover from its endangered, or threatened, status.

VI. PROTECTIVE REGULATIONS FOR THREATENED SPECIES

Pursuant to 50 C.F.R. § 424.14(j), if NMFS determines to list the shortfin mako or an DPS thereof as threatened, we petition the agency to promulgate a 4(d) rule to confer full take protections on the species concurrent with final listing. Given the shortfin mako's biological status and low reproductive rate, the existing regulatory mechanisms that have proven inadequate to conserve the species, and the numerous threats facing the species, including in particular commercial fishing, the shortfin mako should receive full protection under the ESA to ensure its conservation.

Commercial regulation and take protections are paramount to the shortfin mako's recovery. As mentioned above, for example, ICCAT scientists have calculated that catch (including discards) of shortfin mako in the North Atlantic must to be cut to zero for there to be just a 53% chance of rebuilding the stock by 2045 (TRAFFIC 2019, at 3). Under the current ICCAT measures, the population is predicted not to recover by 2070 (TRAFFIC 2019, at 3). Yet, despite the severe decline of the shortfin mako in the North Atlantic and most other oceans, take of the species has not been adequately regulated due to the commercial demand for the species. Further, the impacts commercial overfishing has on the shortfin mako will only be compounded by the many other

threats and biological challenges facing the species. Therefore, if the shortfin mako or any DPS thereof is listed as threatened, the species will require a 4(d) rule that confers full protections under the ESA. Those protections are necessary and advisable to provide for the conservation of the shortfin mako.

VII. SIMILARITY OF APPEARANCE DETERMINATION

While the shortfin mako is the sole subject of this Petition, pursuant to 50 C.F.R. § 424.14(j), we petition that in conjunction with any listing designation for the shortfin mako shark, NMFS also promulgate a 4(e) rule for similar-looking shark species. *See* 16 U.S.C. § 1533(e); 50 C.F.R. § 424.14(c)(2) (2016) ("Only one species may be the subject of a petition, which may include, by hierarchical extension based on taxonomy and the Act, any subspecies or variety, or (for vertebrates) any potential distinct population segments of that species."). If the shortfin mako is listed as threatened or endangered under the ESA, it would be prudent to also protect any unlisted species that closely resembles the shortfin mako in order to prevent the possibility of passing off a protected specimen as an unlisted specimen. This would both facilitate enforcement actions and prevent take of the shortfin mako.

Similar considerations have resulted in the listing of the longfin mako (*Isurus paucus*) alongside the shortfin mako under CITES and CMS (CoP18 Prop. 42 2019, at 13 (listing the shortfin mako based on population declines and the longfin mako based on similarities in appearance); CMS MOS3 2018, at 1–6 (grouping shortfin and longfin mako sharks)). "Longfin and shortfin makos are often caught alongside one another and confused and/or combined in fisheries statistics" (TRAFFIC 2019, at 2). While distinguishable, longfin mako fins are generally grouped with those from shortfin makos and thresher sharks and have a similar market value (TRAFFIC 2019, at 2; CoP18 Prop. 42 2019, at 13). Further, "both [shortfin and longfin makos] are traded for the value of their meat (which amounts to over 90% of the total volume of their body), most of the volume traded is difficult to identify" (CoP18 Prop. 42 2019, at 13). Porbeagle (*Lamna nasus*) meat is also difficult to distinguish from shortfin mako meat (Mundy-Taylor & Crook 2013, at 39).

Because the shortfin mako is so commercially valuable and its parts are difficult to distinguish from similar-looking shark species, if the shortfin mako is listed, it is likely that its parts will be passed off as those of non-protected species. Therefore, Defenders petitions NMFS to also protect similar-looking species with a 4(d) rule. Those protections are necessary and advisable to provide for the conservation of the shortfin mako.

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