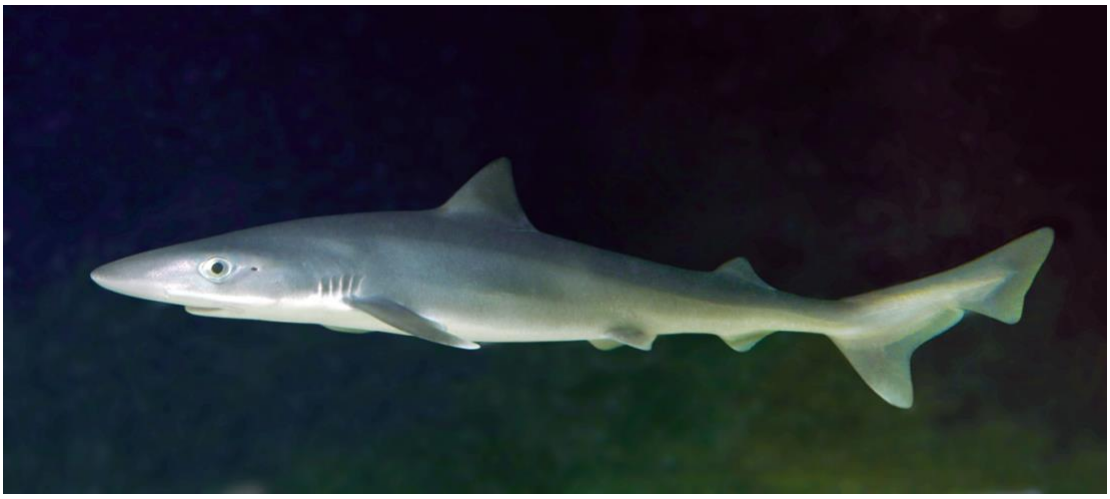
Petition to List the Tope Shark (*Galeorhinus galeus*)
As Endangered or Threatened
Under the Endangered Species Act



Tope Shark. Photo:
Rudie Kuiter / Aquatic Photographic

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

February 15, 2022

Petitioners:

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NOTICE OF PETITION

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Dear Secretary of Commerce,

Pursuant to the Endangered Species Act ("ESA"), 16 U.S.C. § 1533(b), the Defend Them All Foundation and the Center for Biological Diversity formally petition the Secretary of Commerce to list the tope shark (*Galeorhinus galeus*) as an endangered or threatened species and to designate critical habitat concurrent with the listing.

The Secretary of Commerce and the National Marine Fisheries Service ("NMFS"), an agency within the National Oceanic and Atmospheric Administration ("NOAA"), have jurisdiction over this Petition. This Petition sets in motion a specific process, requiring NMFS to make 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.* Petitioner does not need to demonstrate that the listing is warranted, but rather that the information presented demonstrates that such action *may* be warranted. Petitioners believe the best available scientific information demonstrates that listing the tope as endangered is warranted, and the available information clearly indicates that listing the species may be warranted. Therefore, NMFS must promptly make a positive finding on the Petition and commence a status review, as required by 16 U.S.C. § 1533(b)(3)(B).

NMFS must acknowledge the receipt of this Petition within a reasonable timeframe. 50 C.F.R. § 424.14(f)(2).

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

Sincerely,

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Acknowledgments

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Caelle McKaveney, University of San Diego School of Law
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I. Legal and Regulatory Framework

The Defend Them All Foundation and the Center for Biological Diversity formally petition 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 tope shark (*Galeorhinus galeus*) as endangered under the U.S. Endangered Species Act (ESA) and to designate critical habitat for the species within U.S. waters. *See* 16 U.S.C. §§ 1531–1544.

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). In keeping with 50 C.F.R. § 424.14(f)(2), NMFS must 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 References 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).

In reviewing the tope shark's status, NMFS must analyze whether the species warrants listing throughout all or a significant portion of its range. 16 U.S.C. § 1532(6), (20). If NMFS finds that there are distinct population segments (DPSs) of tope shark, it must evaluate each of those DPSs for listing under the ESA.

If NMFS proposes to list the tope shark or any DPS thereof as threatened, Petitioners ask that the agency promulgate a final 4(d) rule to confer full take protections on the species concurrent with a 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 tope shark or any DPS thereof is listed as endangered or threatened, Petitioners ask that NMFS promulgate a 4(e) rule for species similar in appearance to the tope shark. 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."

The agency's review and determination must be based on the best scientific and commercial data available. 16 U.S.C. § 1533(b)(1)(A). This requirement aims to "ensure that the ESA not be implemented haphazardly, on the basis of speculation or surmise." *Bennett v. Spear*, 117 S.Ct. 1154, 1168 (1997).

Listing may be done at the initiative of the Secretary or in response to a petition. 16 U.S.C. § 1533(b)(3)(A). After receiving a petition to list a species, the Secretary is required to determine "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). A "positive" 90-day finding leads to a status review and a determination of whether the species will be listed, to be

completed within twelve months. 16 U.S.C. §1533(b)(3)(B). A "negative" initial finding ends the listing process, and the ESA authorizes judicial review of such a finding. 16 U.S.C. § 1533(b)(3)(C)(ii).

"Substantial information" is defined as the "amount of information that would lead a reasonable person to believe that the measure proposed in the petition may be warranted." 50 C.F.R. § 424.14(b)(1). The four factors to guide the Service's consideration on whether a particular listing petition provides "substantial" information include:

a. Clearly indicates the administrative measure recommended and gives the scientific and any common name of the species involved;
b. Contains detailed narrative justification for the recommended measure; describing, based on available information, past and present numbers and distribution of the species involved and any threats faced by the species;
c. Provides information regarding the status of the species over all or significant portion of its range; and
d. Is accompanied by appropriate supporting documentation in the form of bibliographic references, reprints of pertinent publications, copies of reports or letters from authorities, and maps.

50 C.F.R. § 424.14(b)(2)(i)-(iv).

The ESA does not require "conclusive evidence of a high probability of species extinction" in order to support a positive 90-day finding. *Ctr. for Biological Diversity v. Morgenweck*, 351 F.Supp.2d 1137, 1140 (D. Colo. 2004). Rather, the ESA 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." *Morgenweck*, 351 F.Supp.2d at 1141.

II. Background Summary

The tope shark (*Galeorhinus galeus*), also known as the school shark or soupfin shark (due to its use in shark fin soup), is a small bentho-pelagic shark (Walker et al. 2020, at 1). The species is found in temperate, shallow waters along coastlines around the world, from the west coast of North America to southern Australia in all major oceans, across the Northeast, Eastern Central, Southwest, and Southeast Atlantic, the Mediterranean Sea, the Eastern Indian, and the Pacific (except in the Northwest Pacific) (*Id.*). Tope sharks may be found in offshore habitats at depths up to 826 meters, but primarily occur in nearshore habitats (*Id.*, at 7). These nearshore habitats include shallow bays where pups are raised and remain for up to two years before moving offshore (*Id.*). Tope sharks can live up to sixty years and tend to segregate by size and sex (*Id.*). The tope shark is ovoviviparous giving birth to an average of 20-35 pups per litter (Walker 1999, at 748), and has an unusual triennial reproductive cycle (i.e., they reproduce every three years) (Walker et al. 2020, at 1).

Tope sharks were heavily fished in the early 1900s for their Vitamin A-rich livers (Walker 1999, at 754). While the production of synthetic vitamins has reduced demand, the shark population never recovered (FAO 2021). Population numbers continue to decline, with an estimated 88% reduction in the last 79 years (Walker et al. 2020, at 2). Despite this persistent decline and increased awareness of overfishing, tope shark is still fished, particularly for its fins and meat, and is a highly popular catch in established fish markets worldwide (Hernandez 2013, at i, 21).

Tope sharks' slow maturation rate and tendency to swim in schools segregated by sex and age make them susceptible to overexploitation (Hernandez 2013, at 118; Walker et al. 2020, at 1). Recovery opportunities are currently limited (Walker et al. 2020, at 10). This is because multiple sharks within the same school can be caught simultaneously, often inhibiting breeding by removing the species' reproductive members (*Id.* at 7). Recreational fishing limits vary throughout the world's tope fisheries and fin products have been banned in many places (Hernandez 2013, at 17, 21). However, sport fishing is still authorized and commercial trade of whole tope sharks is often permitted by direct fishing or as a bycatch product (Walker et al. 2020, at 1). The tope shark continues to face fishing pressures, both within the United States territories and globally, leading to population decline (Walker et al. 2020, at 10). Scientific authorities agree that the species is overfished (*Id.*, at 6).

The IUCN categorizes the tope shark as Critically Endangered[1] based on its estimated 88% global population reduction, with the highest probability of >80% reduction over the last three generations (79 years) (Walker et al. 2020, at 6). This species is highly threatened by extinction due to overfishing resulting from commercial trade (for liver-oil, meat, and fins) and incidental bycatch, as well as habitat degradation (*Id.*, at 8-9).

Sharks maintain ocean ecosystems and serve as an indicator of ocean health (Motivarash et al. 2020, at 611). Despite the importance of sharks, few shark species are comprehensively assessed due to the fact that the majority of sharks are caught as bycatch, leaving them vulnerable to exploitation (Silva et al. 2013, at 57). The tope shark's presence in many coastal ecosystems is integral to healthy ecosystems; as a top predator, extinction of the tope can have disastrous effects on the ecosystem at large by destabilizing the food chain balance (*See generally 2017 Shark Finning Report to Congress*, National Oceanic and Atmospheric Administration, at 3). Fishing limitations for both target and incidental catch of the species are necessary to protect the tope shark (Walker 1999, at 755-67).

The Petitioners request the listing of the tope shark as "endangered" under the U.S. Endangered Species Act (ESA) and the concurrent designation of critical habitat for the species within U.S. waters. An ESA listing would significantly improve the species' survival prospects by curtailing present or threatened destruction of habitat, preventing overutilization for commercial and recreational purposes, strengthening inadequate existing regulatory mechanisms, and remedying natural and manmade factors affecting the tope shark's continued existence. In addition, ESA listing would increase global awareness of the species, assist research efforts,

[1] IUCN classified the *Galeorhinus galeus* as "Critically Endangered," or "facing an extremely high risk of extinction in the wild," on Feb. 14, 2020 (*IUCN Red List Categories and Criteria Version 3.1*).

stimulate scientific funding, and provide financial, legal, and political assistance to local and international partnership conservation efforts concerning the tope shark.

III. Species Characteristics

Common Names

Tope, school shark, snapper shark, and soupfin shark (Walker et al. 2020, at 1).

Taxonomy

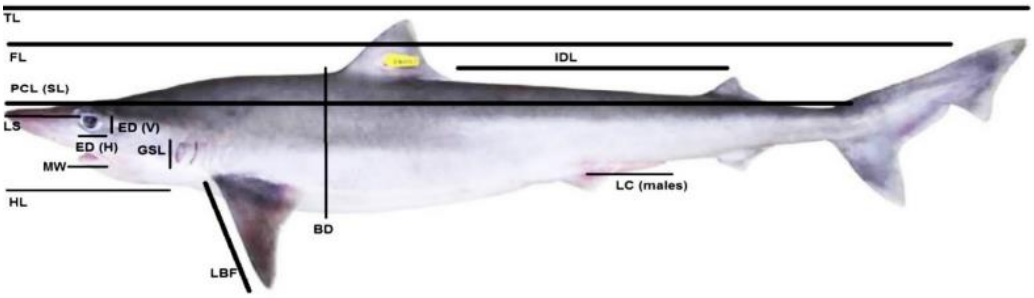
Kingdom	Animalia
Phylum	Chordata
Class	Chondrichthyes
Order	Carcharhiniformes
Family	Triakidae
Genus	*Galeorhinus*
Species	*galeus*

(Caroli Linnaeus, 1758)

Morphological Description

The tope shark is a large, slender shark with a long snout (*Liver Oil Shark*, Encyclopedia of Life). Its large mouth contains sharp, triangular teeth (*Id.*). The large almond-shaped eyes are located in front of pronounced spiracles, which are openings that enable water to be pumped through the gills whilst the shark is resting (*Id.*). The tope shark varies between bluish and dusky grey on top, and blends to white underneath (*Id.*). The tope shark possesses two dorsal fins; the second dorsal fin, situated over the anal fin, is much smaller than the first (*Id.*). Juveniles less than 61 centimeters in length have black tips on their dorsal and caudal fins, with a white edge on the pectoral fins (*Id.*). The maximum reported size of the species is 6.3 feet total length for a male specimen and 6.4 feet total length for a female (*Galeorhinus galeus*, Florida Museum). The maximum published weight is 98.5 pounds, or 44.7 kg (*Id.*).[2]

[2] This Petition uses the female maximum weight of 45.4 kg (100 lbs) in weight conversions. *See* Washington Department of Fish and Wildlife, *Soupfin (Galeorhinus galeus)*.



a. Total length (TL): Tip of the snout to the tip of the tail.

b. Fork length (FL): Tip of the snout to the fork of the tail.

c. Pre-caudal length (PCL): Tip of the snout to the pre-caudal notch (sometimes referred to as Body Length (BDL) and standard length (SL) as well.

d. Inter-dorsal length (IDL): First dorsal to second dorsal fin.

e. Eye diameters (ED), vertical (V) and horizontal (H).

f. Body depth (BD).

g. Mouth width (MW).

h. Gill slits length (GSL).

i. Head length (HL).

j. Length of Snout (LS).

k. Length of tail (LT).

l. Length of pectoral fins (LPF)

m. Length of claspers LC (males).

n. Clasper outer margin length

o. Clasper inner margin length

p. Clasper base width

q. Tail width at pelvic base ends

r. Nostril width

Visual Aid for the Physicalities of the Tope (Buzaid 2017, at 37).

Habitat, Distribution, and Migratory Behaviors

The tope shark occurs in all major oceans: across the Northeast, Eastern Central, Southwest, and Southeast Atlantic, the Mediterranean Sea, the Eastern Indian, and across the Pacific—except in the Northwest Pacific (Walker et al. 2020, at 1; *Galeorhinus galeus*, Shark-References). Tope sharks occur on continental shelves and upper- to mid-slopes from shallow inshore to well offshore to depths of 826 m, though most occur frequently at 200 m (Walker et al. 2020, at 1).

Tope sharks are known for far-ranging seasonal migrations that cross multiple states and/or national borders, including the United States (*Proposal for the Inclusion of the Tope Shark*

((Galeorhinus galeus)*) in Appendix II of the Convention*, Convention on Migratory Species). One tagging study discovered a tope shark in British Columbia nearly 1000 miles from its original California location (*Id.*).

Recent research suggests that tope sharks prefer to separate themselves by sex (Walker et al. 2020, at 7). For example, most tope sharks found in Southern California are females while males predominate from Northern California to British Columbia (*Meet the Locals: Soupfin Sharks*, Birch Aquarium). In central California, some overlap with an equal ratio occurs (*Tracking California Soupfin's Sharks to La Jolla Shores*, Shark Stewards). The entire west coast of the United States is prime tope shark territory, as the shark pools in five zones, ranging from La Jolla (San Diego County), the rest of San Diego, Orange and Los Angeles Counties (including Santa Catalina Island), Ventura and Santa Barbara Counties (including the Northern Channel Islands), San Luis Obispo through Sonoma Counties (including San Francisco Bay and the Farallon Islands), and Oregon and Washington (Nosal et al. 2020, at 1572).

Map of tope shark distribution (Walker et al. 2020).

Map of Tope distribution in the continental United States (Walker et al. 2020).

Biological Characteristics

The diet of tope sharks consists mainly of small shoaling demersal teleost fish (such as boarfish (*Capros aper*) and snipefish (*Macroramphosus scolopax*)) and cephalopods (Walker 1999, at 752; Morato et al. 2003, at 590). In California, tope sharks commonly feed mostly on flatfish, midshipman (*Porichthys*), sardine, mackerel, and rockfish (*Id.*, at 753). Other prey fish include pilchards, herring, sardines, anchovies, salmon, smelt, hake, cod, midshipmen, flyingfish, barracuda, mackerel, tuna, croakers, wrasses, damselfishes, gobies, kelpfish, sole, halibut, scorpionfish, and sculpins (*Galeorhinus galeus*, Florida Museum). Juvenile tope sharks residing in inshore nursery areas take in a greater proportion of cephalopods, crustaceans, gastropods, and annelids (*Id.*). Seasonal abundance and availability of various prey types are often reflected in the shark's diet (*Id.*).

Tope sharks have a low biological productivity, late maturity (average 12.5 years), and three-year reproductive cycle, causing them to be highly vulnerable to overfishing (Walker et al. 2020, at 1, 8; Peres & Vooren 1991, at 655; Francis & Mulligan 1998, at 427; Bovcon et al. 2018, at 1). Reproduction is aplacental viviparous, with average litter sizes between 25 and 30 following a ~12 month gestation period (Walker 1999, at 748). Male tope sharks reach maturity at approximately 5 feet (152 cm) in length at the age of 12-17 years; females mature at about 5.8 feet (177 cm) in length at the age of 13-15 years (*Galeorhinus galeus*, Florida Museum).

California is a breeding ground for tope shark (*Tracking California Soupfin's Sharks to La Jolla Shores*, Shark Stewards). Reports suggest that the sharks occupy warmer than average waters to incubate their embryos to minimize the gestation period, which is 12 months (Nosal et al. 2021). After giving birth in warmer waters, such as La Jolla, the adult sharks travel along the central California coast, between San Francisco and the Channel Islands (*Id.*). Pups remain in the nursery grounds for up to two years (Walker et al. 2020).

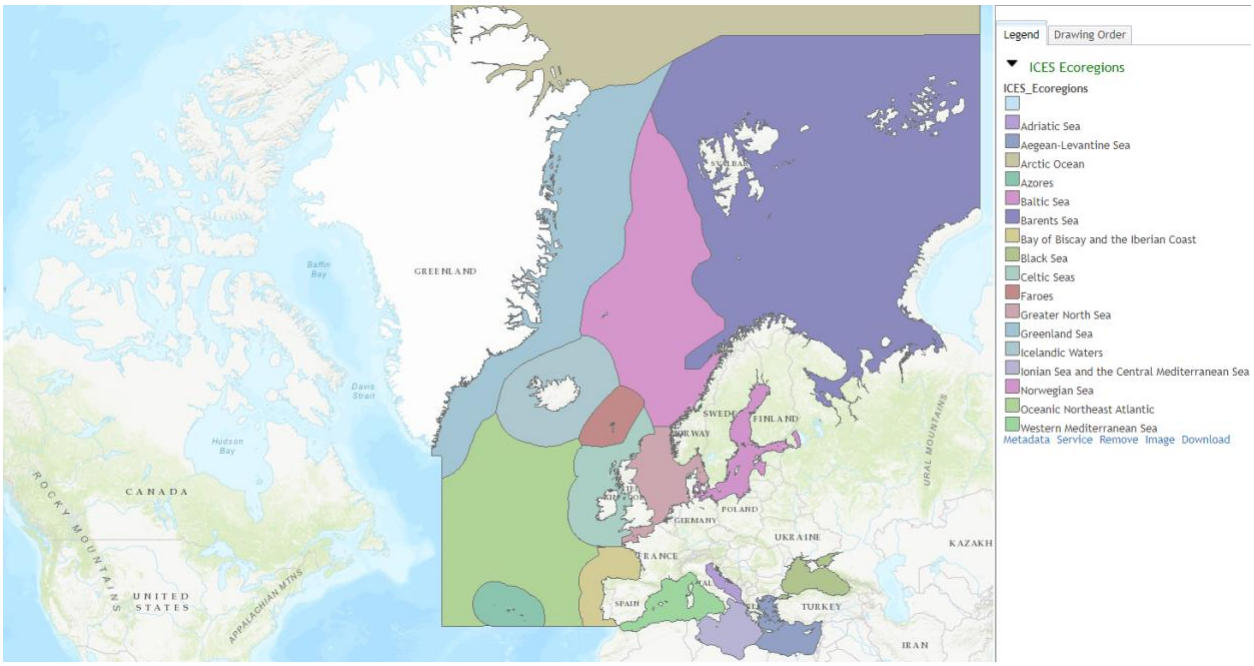
Scientists recognize six genetically distinct subpopulations of tope shark: (1) Northeast Atlantic (including the Mediterranean Sea), (2) southern Africa (Namibia to East London, South Africa), (3) Southwest Atlantic (southern Brazil to Patagonia), (4) Northeast Pacific (British Columbia to southern Baja California, including the Gulf of California), (5) Southeast Pacific (Ecuador to Chile), and (6) Australasia (Australia and New Zealand) (Márquez, *Coming Home: Tope Sharks Return After Three Years*; Walker et al. 2020, at 5; Chabot & Allen 2009, at 545). While tope sharks move extensively between subpopulations, there is no evidence of interbreeding (*Id.*). The population status and trend of each subpopulation are described in the following section.

Population Status and Trends

The tope shark's global population is estimated to have undergone a dramatic reduction of 88%, with the highest probability of >80% reduction over the last three generations (79 years) due to unsustainable levels of exploitation (Walker et al. 2020, at 2). An alarming downward trend has been observed across all subpopulations and is anticipated to continue if conservation measures are not established (Chabot & Allen 2009, at 545). To date, the global shark fin trade has significantly hindered the tope shark's ability to survive (Walker et al. 2020, at 8). Hong Kong, the largest importer of shark fins, and Thailand, the largest exporter of shark fins, cause catastrophic harm to sharks and their ocean ecosystems (*2017 Shark Finning Report to Congress*, National Oceanic and Atmospheric Administration, at 3). However, the United States is directly implicated in this trade, through both imports and exports of shark fins to other countries (*Id.*, at 6).

<u>Stock 1: Northeast Atlantic (including the Mediterranean Sea)</u>

The Northeast Atlantic estimates the population through standardized catch-per-unit-effort (Walker et al. 2020, at 5). The trend analysis of these survey data combined for 1990–2018 (29 years) revealed annual rates of reduction of 1.7%, consistent with an estimated median reduction of 76.6% over three generation lengths (79 years), with the highest probability of >80% reduction over three generation lengths (*Id.*). This trend is largely driven by higher catch rates at the start of the time-series and more recent data indicating a stabilizing trend (*Id.*). The combined data indicate declining catches until the 2000s, when catches began to increase slowly (*Id.*). The International Council for the Exploration of the Sea ("ICES") recommended landings be limited to 376 t [approximately 8,281 individual female tope weighing 45.4 kg] annually in 2018 and 2019 (*Id.*, at 8). However, the annual reported tope landings of the Northeast Atlantic subpopulation from 2005–2018 across ICES areas was 542–715 t [approximately 11,938–15,748 individual female tope weighing 45.4 kg] (*Id.*).



Map of ICES areas (International Council for the Exploration of the Sea)

The subpopulation in the Northeast Atlantic has been stable recently, possibly due to additional management measures (Walker et al. 2020, at 2). European Union vessels are prohibited from landing tope on longlines over a large part of the species' northern European range in ICES waters (*Id.*). Tope fishing has been prohibited in the United Kingdom since 2008 except for using rod and line (*Id.*, at 10). Anglers using rod and line from boats are not allowed to land their catch, and bycatch of tope caught in other commercial gear is limited to 45 kilograms per day (*Id.*). In the Mediterranean Sea, the General Fisheries Commission for the Mediterranean banned retention and mandated careful release for tope and 23 other elasmobranch species listed on the Barcelona Convention Annex II in 2012 (*Id.*).

Stock 2: Southern Africa (Namibia to East London, South Africa)

South Africa's JABBA stock assessment indicated declining stocks of tope shark from 1952-2016 (65 years) (*Id.*). Currently, the biomass is 10-14% of pre-exploitation levels (*Id.*, at 6). Population data assessments were conducted through scientific surveys and commercial catches in the demersal shark longline, line, and trawl fisheries (*Id.*). Based on the trend analysis of the biomass, the stock assessment revealed annual reduction rates of 3.1%, consistent with an estimated median reduction of 91.4% over three generation lengths (79 years), with the highest probability of >80% reduction over three generation lengths (*Id.*).

There is a >99% probability that tope shark stocks in South Africa are currently overfished and subject to overfishing (Winker et al. 2020, at 1). Tope is fished intentionally and is also a victim of bycatch in South Africa (*Id.*, at 10). Annually, 100–400 t of tope shark [approximately 2,202–

8,810 individual female tope weighing 45.4 kg] is caught in demersal and pelagic line, trawl, gillnet, and recreational fisheries (Walker et al. 2020, at 9).

Currently, seasonal no-take zones in Marine Protected Areas ("MPAs") provide some protection to the tope shark (Breen et al. 2015, at 75). However, to be effective in protecting the sharks, they must remain within the protected boundaries (Silva et al. 2013, at 57). Although the time sharks spend within MPAs has been understudied, research indicates that sharks in the no-take Langebaan Lagoon Marine Protected Area ("LMPA") spent an average of 74% and 80% of the time inside the MPA (*Id.*). While inside the LMPA, tope shark are protected from the inshore trawl fishery, demersal shark longline fishery, and the commercial rod and reel fishery, which are normally targeted commercially off the Southern and Eastern Cape coasts in South Africa, as well as occasionally commercial fishing on the Western Cape coast (*Id.*, at 64).

Stock 3: Southwest Atlantic (Southern Brazil to Patagonia)

The Southwest Atlantic region tracks population trend data through Nominal Catch Per Unit Effort (Walker et al. 2020, at 6). Tope shark declined dramatically in importance in the commercial chondrichthyan catch in Argentina from 1984-2015, dropping from 40% to 2% (*Id.*). A matrix population model of data from the cargo ship Bahía San Blas found a decrease in the subpopulation at an average annual rate of 6.7% to 12.8% from 1998–2001 (*Id.*). Nominal CPUE from Argentina for 1992–2015 (24 years) was available from demersal trawl fisheries, showing an annual rate of reduction of 5.9%, equaling an estimated median reduction of 99.3% over three generation lengths (79 years), with the highest probability of >80% reduction over three generation lengths (*Id.*). This is despite seasonal no-take areas within the Southwest Atlantic, which provide some protection to the tope (*Id.*, at 10).

Tope shark in the Southwest Atlantic, subjected to periods of intensive fishing in the mid-1940s, also faced artisanal fishing pressure (Walker et al. 2020, at 8). In Uruguay, artisanal fisheries targeted tope with gillnet and longline during 1940–1980 (*Id.*). Tope in this region severely declined after 2000; while this led to decreased longline targeting of tope, this species is still landed as bycatch by several other fisheries (*Id.*). In Argentina, for example, approximately ~ 600 t of tope [approximately 13,215 individual female tope weighing 45.4 kg] were landed as bycatch in 2015 (*Id.*).

Additionally, the Province of Buenos Aires prohibits the landing of tope in recreational fisheries (Walker et al. 2020, at 10). However, tope remains inadequately protected by regional, national, and provincial legislation in Argentina which protects all sharks larger than 160 cm TL (the largest tope in Southwest Atlantic is 155 cm TL) (*Id.*). Additionally, enforcement is difficult, and the tope shark is still subject to intensive fishing (*Id.*).

Stock 4: Northeast Pacific (British Columbia to southern Baja California including the Gulf of California)

In the Northeast Pacific, a dramatic decline in the subpopulation occurred in the early 1940s, with no recovery until 1997–2004, when management measures led to a localized increase in abundance (Walker et al. 2020, at 9). There is some recovery in part of the Northeast Pacific, such as in Canada where a mandatory release policy has been in effect since 2011 (*Id.*). Despite this, consistently steep reductions across most of the analyzed subpopulations and stocks, together with the minimal movement between the subpopulations, are cause for serious concern (*Id.*, at 2). There has not been a stock assessment or fishery management plan enacted, so the abundance of individual tope in the United States is largely unknown (Nosal et al 2020, at 1579).

Catch of tope in the Northeast Pacific peaked at >4,000 t [approximately 88,105 individual female tope weighing 45.4 kg] in 1939, then rapidly fell to 287 t [approximately 6,321 individual female tope weighing 45.4 kg] by 1944 with the depletion of stocks (Walker et al. 2020, at 9). Approximately 840,000 individuals, primarily large adults, were killed for their livers from 1937–1949 (*Id.*). Recently, Canadian bycatch has averaged 0.5 t/year and 1.8 t/year since 2006 in the trawl and hook and line fisheries, respectively, with mandatory release elsewhere since 2011 (*Id.*). During 1976–1994, 100–380 t of tope [approximately 2,202–8,370 individual female tope weighing 45.4 kg] was landed on the U.S. west coast, mostly in California. Landings decreased in 1990–2004 by about half (*Id.*). Landings in US waters for 1990–2016 totaled 840 t, of which 816 t [approximately 17,973 individual female tope weighing 45.4 kg] was caught in California (*Id.*). Fishing gear, such as gill nets, are particularly harmful to the tope shark (Pondella & Allen 2008, at 307). Estimates regarding the catch from recreational fishing are unavailable (*Id.*).

In the Northeast Pacific, California's tope shark population collapsed due to overfishing from 1938–1944 (Walker et al. 2020, at 7). The subpopulation did not show any signs of recovery until prohibitions on the use of inshore gillnets and trammel nets were enacted for the white sea bass (*Atractosciaon nobilis*) and giant sea Bass (*Stereolepis gigas*) in 1994 (*Id.*). Through these prohibitions, the catch of inshore tope decreased (*Id.*). Gillnet surveys in the southern California Bight indicated a tope shark population increase from 1977–2004, but since there was no increase in the total Californian commercial landings of tope at this time, the rise is believed to be only from a localized increase in abundance from increased survival of pups and older tope recolonizing inshore waters (*Id.*). Although this indicated localized stocks can recover following management that prohibits catch, it is not indicative of a widespread increase in abundance of tope in all California waters (*Id.*).

Stock 5: Southeast Pacific (Ecuador to Chile)

Catches of tope shark throughout the waters of Ecuador, Peru, and Chile are low despite intensive and diverse fisheries, including the widespread use of gillnets of mesh sizes 50–200 mm, which are particularly efficient for tope capture (Walker et al. 2020, at 9). The lack of catch data indicates that the tope shark has been regionally extirpated, due to the immense fishing operations within this area (Gonzalez-Pestana et al. 2016, at 1). In Ecuador and Peru, there is no mention of tope in the chondrichthyan species reported to the Food and Agriculture Organization of the United Nations (Walker et al. 2020, at 9). In Chile during 1976–1995,

reported annual catches were often zero but increased to 11 tons in 1979, to a peak of 36 tons in 1980, decreased to six tons in 1992, and subsequently to zero (*Id.*). Official landings statistics to 2017 include only one ton for 2009 (*Id.*). However, it is believed that the catch is underreported because the tope is viewed as "an unimportant fishery product" in this region (*Id.*). Visual inspection and DNA testing of landed shark fins in Chile also indicate low catches of tope (*Id.*).

Stock 6: Australasia (Australia and New Zealand)

Australian and New Zealand tope sharks comprise the Australiasian subpopulation. Tagging data from larger tope sharks have revealed national and international migration patterns in and between Australian and New Zealand waters (Hernandez 2013, at 113). Due to the relatively high emigration rates from New Zealand to Australian waters, the species is considered to be the same subpopulation (*Id.*, at 8). Despite this, the subpopulation's Australia and New Zealand components are treated as separate stocks for fisheries, conservation management, and risk assessments in Australia and New Zealand (Walker et al. 2020, at 6).

Australia

Stock assessments indicate that the current biomass is <20% of unexploited levels and the stock is considered overfished (Walker et al. 2020, at 6). Current levels of fishing mortality are uncertain (*Id.*). Trend analysis of the stock assessment abundance for 1927–2000 (74 years) revealed an annual rate of reduction of 2.8%, consistent with an estimated median reduction of 90.1% over three generation lengths (79 years), with the highest probability of >80% reduction over three generation lengths (*Id.*).

In Australia, tope is primarily taken through the Shark Gillnet and Shark Hook sectors of the Southern and Eastern Scalefish and Shark Fishery ("SESSF") (Walker et al. 2020, at 9). Since 1990, tope shark has been primarily caught as bycatch when fishing for gummy shark (*Mustelus antarcticus*) (*Id.*). SESSF annual catches of tope are ~150–200 t [approximately 3,303–4,405 individual female tope weighing 45.4 kg], and all other catches, across the rest of Australia, are ~24 t annually (*Id.*). The Australian population of tope shark benefits from the immigration of large, mature animals from New Zealand as well as additional conservation protections designed to protect the species; these measures have allowed the stock to stabilize since 2000 (*Id.*, at 6).

Despite conservation efforts in the region, there is little evidence of stock recovery (Hernandez 2013, at 11). As recently as September 2010, additional measures were being considered, including restrictions of co-occurring target species and area closures, in an effort to protect the tope (*Id.*).

New Zealand

Standardized catch-per-unit-effort data shows a general decline of tope shark catches during the 1990s, followed by a rise in catches in the early 2000s, with fluctuating catches across areas and gear (Walker et al. 2020, at 6). The high fluctuation in data is considered a result of varying spatial and temporal patterns of fishing and migration of tope (*Id.*). Trend analysis of combined longline and gillnet data from 1990–2016 (27 years) revealed annual rates of reduction of 0.5%, consistent with an estimated median reduction of 29.8% over three generation lengths (79 years), with the highest probability of 30–49% reduction over three generation lengths (*Id.*). Additionally, the New Zealand tope population is hindered by the immigration of the large, sexually mature sharks into Australia (*Id.* at 2, 6).

In New Zealand, tope catches peaked in 1984, and ~3,000 t [approximately 66,079 individual female tope weighing 45.4 kg] have since been caught annually (Walker et al. 2020, at 9). Tope sharks are managed under the Quota Management System (*Id.*, at 10). Individual Transferable Quotas under the QMS allow for a recreational bag limit of 20 tope sharks per fisher per day (*Id.*).

The Tope Shark satisfies the criteria for listing as an Endangered Species

The Endangered Species Act (ESA), 16 U.S.C. §§ 1531 et seq., was intended "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, [and] to provide a program for the conservation of such endangered species and threatened species." 16 U.S.C. § 1531(b). The protections only apply to species listed as endangered ("in danger of extinction throughout all or a significant portion of its range." 16 U.S.C. § 1532(6); *see also* 16 U.S.C. § 533(a)(1)) or threatened ("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). Under the Endangered Species Act, the term "species" includes "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).

Under the ESA, the NMFS "shall . . . determine whether any species is an endangered species or threatened species on the basis of any of the following factors:"

a. 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. Inadequacy of existing regulatory mechanisms; or
e. Other natural or manmade factors affecting its continued existence.

16 U.S.C. § 1533(a). A species must only meet one of these factors to qualify for federal listing. 50 C.F.R. § 424.11.

As a benthopelagic species, the tope shark occupies most of the water column and is vulnerable to human activities from the surface to the seafloor (Thornburn et al. 2019, at 2). Dramatic declines in the species' wild populations have been primarily attributed to relentless overexploitation for human consumption and bycatch (Walker et al. 2020, at 1-2). Habitat degradation and a lack of critical legal and regulatory protections are further exacerbating pressures driving the species to extinction (*Id.*, at 9-10). The accumulation of past and present threats have resulted in an approximately 80% reduction in the global tope population over the last three generations (79 years) (*Id.*, at 1).

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

Chondrichthyes (sharks and rays) like the tope are considered highly susceptible to anthropogenic pressures near coastlines and in offshore environments (Leonetti et al. 2020, at 1). This is especially true for highly migratory species like the tope sharks tagged in southern California, which are susceptible to threats in the United States and Mexico (Nosal et al. 2021). Climate change and coastal development are especially harmful to tope given the species' dependence on shallow warm areas for gestation pup rearing and juvenile development for up to 2 years (*Tope Shark*, Edge).

i. Climate Change Threatens the Tope Shark with Extinction

Habitat degradation and destruction associated with climate change threaten the tope shark with extinction. "Climate changes affect the physics and chemistry of the world's oceans and have the potential to alter every functional relationship in the marine food web either directly or indirectly" (Tester 1996, at 191). Sharks are highly likely to shift their distribution or expand into new habitats to follow preferable ocean conditions due to climate change (*Effects of Climate Change on Sharks*, NMFS). The effects of climate will lead to significant changes in phytoplankton biomass and shifts in species dominance (*Id.*). An increase in global temperature reduces the turbulent mixing intensity in oceans, which is the leading factor in decreasing the total biomass of phytoplankton (Károly et al. 2020, at 612). The importance of phytoplankton is immeasurable, as they are responsible for nearly 50% of global net primary production, are the primary energy source for aquatic ecosystems, and are of global significance for climate regulation and biogeochemical cycling (Moisan et al. 2013). As the foundation of the marine food web, phytoplankton support successive trophic levels such as zooplankton, organisms that feed on zooplankton such as fish, and then predators that feed on the fish such as seals, sea lions, sharks, and marine mammals (Alberro 2014). Therefore, organisms at the very top of the food chain, including apex predators such as sharks, ultimately depend on the ecological base that is formed by phytoplankton (*Id.*). Declines in phytoplankton can result in a significant decline in zooplankton populations, which in turn affect secondary and tertiary-level consumers, such as fish and sharks (*Id.*).

Climate change will also disrupt the ocean's biodiversity by increasing the mortality rate of deep-sea predators, including sharks (Rosenberg 2021). Rising temperatures on earth, which mainly impact the ocean, go far beyond death, extinctions, and habitat loss; instead, rising temperatures alter fundamental processes, leading to reorganization and ecological surprises (Shah 2014). This will create trophic cascades as reduced predation leads to a proliferation of herbivore species, consequently increasing pressures on marine flora, whose growth would also be stunted by rising ocean temperatures (*Id.*). In effect, the loss of sharks would likely be catastrophic to marine ecosystems, "exacerbating stresses on already highly degraded coastal benthic systems" (Myers et al. 2007, at 1849-50). Of most concern, however, is the impact that ocean change will have on ocean acidification, ocean stratification, and oceanic dead zones (Shah 2014).

In addition to warming the ocean, climate change contributes to ocean acidification. The global ocean absorbs approximately 31% of anthropogenic CO_2 emissions, which results in increased ocean acidity (Gruber *et al.* 2019, at 27; Dixson et al. 2014, at 1). This acidification affects shark physiology and survivability (Dixson et al. 2014, at 6-7).

Studies conclude that there are "clear effects on body condition, growth, aerobic potential and [behavior] (e.g. lateralization, hunting and prey detection)" of sharks due to elevated CO_2 (Rosa et al. 2017, at 1). For example, while ocean acidification may hasten embryonic development, elevated temperature in conjunction with elevated CO_2 harms sharks by increasing energetic demands while decreasing metabolic efficiency and reducing sharks' ability to locate food through olfaction (Pistevos et al. 2015, at 1). The ramifications of increasing ocean acidification could result in reduced growth as well as survival rates of pups through a decreased ability to smell and, therefore, hunt (*Id.*). Additionally, acidic oceans may corrode the teeth of certain shark species, which would lead to higher mortality rates (Dziergwa et al. 2019, at 5-6).

Global climate change also increases the frequency and severity of environmental challenges in tope shark habitats, specifically estuarine habitats (Morash et al. 2016, at 1). These challenges may negatively affect elasmobranch physiology, through "a decrease in plasma osmolality brought about by selective losses of NaCl, urea and trimethylamine *N*-oxide, as well as decreases in haemoglobin, haematocrit and routine oxygen consumption" (*Id.*, at 2). Although the species "seemed to be able to cope with this level of osmotic challenge," the tope shark:

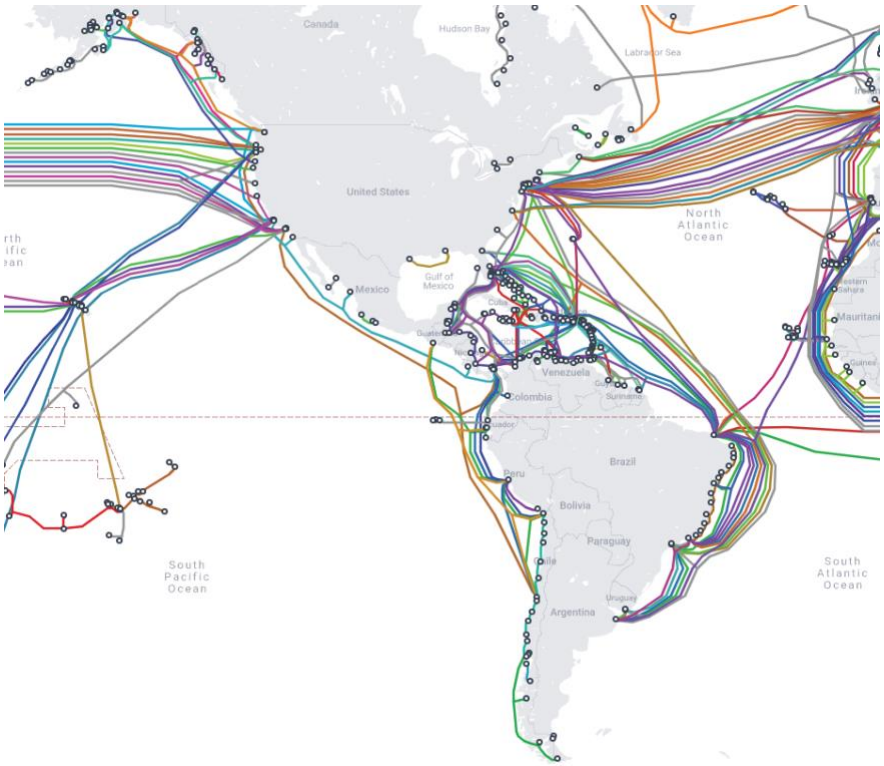
> exhibited higher gill Na+/K+-ATPase activity and ubiquitin concentrations in routine and experimental conditions, a larger heat-shock protein response and a smaller decrease in routine oxygen consumption during the hyposmotic exposure, suggesting that there are species-specific responses that could potentially affect their ability to withstand longer or more severe changes in salinity (*Id.*, at 1).

Furthermore, climate change-mediated weather events such as extreme rainfall may restrict the species from using the estuarine environment, putting them at greater risk of predation (*Id.*, at 11).

Studies of other shark species describe additional impacts that tope sharks might suffer as climate change progresses. For example, one study showed that small-spotted catsharks (*Scyliorhinus canicula*) exposed to current carbon dioxide levels exhibited a "shift in their nocturnal swimming pattern from a pattern of many starts and stops to more continuous swimming" (Green & Jutfelt 2014, at 1).

ii. Coastal and Ocean Development Threatens the Tope With Extinction

One aspect of coastal and ocean development that threatens the tope with extinction is the placement of high voltage subsea cables. High voltage direct current subsea cables are believed to negatively impact the tope and other sharks across their migration lanes, especially when feeding and navigating (Walker et al. 2020, at 9). Negative effects of the electric fields created by the subsea cables include effects on predator/prey interactions; avoidance/attraction and other behavioral effects; effects on species navigation/orientation capabilities; and physiological and developmental effects (Taormina et al. 2018, at 16; Carter et al. 2009, at 32). Therefore, both the placement of subsea cables across migration lanes and the utilization of them could be adverse to the tope (Walker et al. 2020, at 9; *see* Taormina et al. 2018, at 16).



(*Submarine Cable Map*, TeleGeography)

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

Range-wide overutilization is the primary factor driving the tope shark's dramatic decline toward extinction (*Tope Shark*, Edge). Commonly served as a luxury dish called "shark fin soup," fins of sharks including tope are considered a status symbol in some cultures and have gained popularity across Asia as well as the rest of the world (*From Head to Tail: How European Nations Commercialise Shark Products*, Oceana, at 1). As a result, the tope shark, also known as the "soupfin shark," has been overexploited by humans (*Proposal for the Inclusion of the Tope Shark ((Galeorhinus galeus)) in Appendix II of the Convention*, Convention on Migratory Species). While publicity campaigns have reduced the consumption of shark meat and fins in the United States, finning remains a primary threat to shark species as 73 million sharks end up in the global shark fin trade annually (*From Head to Tail: How European Nations Commercialise Shark Products*, Oceana, at 4-5; Mustain et al., at 1). Despite a clear, international consensus that sharks should be protected globally, sharks—including the tope shark—continue to be exploited into extinction (*Id.*, at 3).

In addition to meat and fins, Tope is harvested for squalene, a lipid in shark livers (Scholl et al. 2021, at 66). Known for having the highest concentrations of vitamin A of any fish in the region, tope sharks on the Pacific Coast are often targeted for this purpose (*COSEWIC Assessment and Status Report on the Tope Galeorhinus galeus*, Committee on the Status of Endangered Wildlife in Canada, at v). While an abundance of plant-based and synthetic alternatives exist, shark-derived liver oil remains in high demand for use in cosmetics, pharmaceuticals, dietary supplements, sunscreens, and biofuels (Scholl et al. 2021, at 66).

In addition to being targeted directly in fisheries, the tope shark is particularly vulnerable to incidental capture as bycatch in pelagic gillnet and longline fisheries, as well as trawl, hook-and-line, troll lines, trammel nets, and traps due to their preference for teleost fish and tendency to swim in schools (*Proposal for the Inclusion of the Tope Shark (Galeorhinus galeus) in Appendix II of the Convention*, Convention on Migratory Species). For sharks caught as bycatch and released by industry, the vessel-mortality rate ranges from 2-73% with gillnets and 0% with longlines (Walker et al. 2020, at 8). The danger posed by gillnets is largely dependent on the mesh size (*Id.* at 9). Bycatch animals become entangled in this mesh around their necks, mouths, and flippers, which prevents proper feeding, constricts growth, causes infection, or leads to extreme fatigue (*Fishing Gear: Gillnets*, National Marine Fisheries Service).

Both targeted and incidental capture is more likely to occur in bays and estuaries, where gravid females are known to seek refuge to give birth (Ferguson, *Galeorhinus galeus – Tope*). The capture of pregnant females is of particular concern even if they are subsequently released alive because the estimated capture-induced parturition rate ranges from 2 to 85% of pregnant females (average 24%) (Adams et al. 2018, at 11). Abortion in elasmobranch fishes is a well-known post-capture stress behavior, either due to the intrauterine decrease in oxygen level or removal from the water and loss of water pressure (Rincon 2007, at 53).

Locating pupping areas of the tope shark is incredibly difficult, as the species is highly selective of potential locations. However, Engaño Bay in the Southwest Atlantic represents a particular location of interest, as it is believed there is a tope shark pupping area there (Bovcon et al. 2018, at 2). Despite this critical location, sport-recreational anglers fish in this area (*Id.*).

C. Disease or Predation

Neither disease nor predation are the main concerns of the tope shark's continued survival and persistence.

Parasites including *Anthobothrium galeorhini* n. sp. (Eucestoda: Phyllobothriidae) have been collected from the spiral intestine of the tope shark in the Atlantic coastal region (Suriano 2002, at 121).

Predators of the tope shark include the white shark (*Carcharodon carcharias*) and the sharpnose sevengill shark (*Heptranchias perlo*) (Rigby et al. 2018; Finucci et al. 2019). Potential predators include other large sharks, as well as marine mammals including California sea lions (*Zalophus californianus*) (Aurioles-Gamboa et al. 2014; *Galeorhinus galeus*, Florida Museum, at 3).

D. Inadequacy of Existing Regulatory Mechanisms

Current conservation regulations are ineffective to ensure the survival of the tope shark (Walker 1999, at 755-67). Few conservation measures are present throughout the tope shark's global range, despite growing international awareness of threats to the species (*Galeorhinus galeus*, Convention on the Conservation of Migratory Species of Wild Animals).

International

International regulatory mechanisms fail to protect the tope shark from extinction (Walker et al. 2020, at 1, 10). While the tope shark was listed under Appendix II of the Convention on Migratory Species ("CMS")[3] in 2020, the CMS is only a framework convention from which separate instruments can evolve. It does not directly protect the species (*Appendix I & II of CMS*, Convention on the Conservation of Migratory Species of Wild Animals).

The tope shark continues to be exploited globally at the behest of organizations, such as the International Game Fish Association, that recognize the tope shark as a "game fish" and note

[3] This listing is reserved for migratory species that have an "unfavourable conservation status and that require international agreements for their conservation and management, as well as those that have a conservation status which would significantly benefit from the international cooperation that could be achieved by an international agreement" (*Appendix I & II of CMS*, Convention on the Conservation of Migratory Species of Wild Animals).

that the species provides “excellent sport” (Burgess, *Tope or School Shark is Regarded by the IGFA as a Game Fish*).

Northeast Atlantic

Regional protections likewise fall short of affording the tope protection from existential threats including fishing (Walker et al. 2020, at 1, 10). In the Northeast Atlantic, daily catch limits and gear restrictions are in place in the UK and the EU prohibits the taking of tope shark by longline over a large part of the northern European range (*Galeorhinus galeus*, Convention on the Conservation of Migratory Species of Wild Animals). However, bycatch of tope caught is still allowed with up to 45 kilograms per day (Walker et al. 2020, at 10; Bonanomi et al. 2019, at 7, 67). The regulatory mechanisms in place are insufficient to protect the tope from extinction.

South Africa

In South Africa, no conservation measures are in place for the tope (*Galeorhinus galeus*, Convention on the Conservation of Migratory Species of Wild Animals). As such, regulatory mechanisms inadequately protect tope in South African waters.

Southwest Atlantic

In the southwest Atlantic, seasonal restrictions are used only in areas with increased occurrences of gravid females (*Galeorhinus galeus*, Convention on the Conservation of Migratory Species of Wild Animals). Such restrictions insufficiently protect the general tope shark population.

Northeast Pacific - United States

Regulatory mechanisms in the United States remain inadequate to protect the tope shark from extinction (Walker et al. 2020, at 1, 10). Importantly, in the United States, the tope shark is neither actively managed nor recognized as a highly migratory species despite research showing highly migratory behavior (Nosal et al. 2021). Researchers off southern California tracked 34 adult females for seven years, and at least six (15%) were killed in commercial gillnets in Mexico, indicating a high risk of bycatch and entanglement (*Id.*).

While some states have examined the implications of the shark fin trade and worked to pass legislation to end the devastating practice, these regulations do not go far enough (*Ending the Shark Fin Trade*, Oceana). Moreover, because protections focus on prohibiting retention (through size and catch limits or gear restrictions) instead of avoiding catch altogether, the tope shark continues to suffer from bycatch and post-capture mortality that hinders population recovery (*Ending the Shark Fin Trade*, Oceana). Bycatch of tope has declined over the past century as additional management measures have been enacted, yet the population has not recovered (Walker et al. 2020, at 9). Furthermore, estimates of recreational fishing data, both historical and ongoing, are unavailable (*Id.*).

Federal legislation has been ineffective at adequately increasing the tope shark's population (Walker et al. 2020, at 1, 10). The Shark Conservation Act, for example, strengthened the shark finning ban, but does not ban the capture of sharks altogether (*Shark Conservation Act*). The Magnuson-Stevens Act ("MSA") is designated to reduce bycatch and successfully evaluate the optimum level of utilization of marine species but does not adequately protect the tope shark from fishing pressures (*Magnuson-Stevens Act*). Furthermore, the federal MSA does not address the consumption of shark fins itself (*Id.*).

To date, 13 states have enacted bans on the sale and possession of shark fins (*Ending the Shark Fin Trade*, Oceana). These "bans" vary in the level of protection afforded to tope shark (*Id.*). For example, California's 2011 law bans the selling or possession of any shark-fin products throughout the state (*Meet the Locals: Soupfin Sharks*, Birch Aquarium, at 1). However, the tope shark can still be caught in recreational fisheries with a daily bag limit of one fish and no minimum size requirement (*Current California Ocean Recreational Fishing Regulations – Southern Region*, California Department of Fish and Wildlife). Florida's 2020 law banned the import and export of shark-fin products but continues to permit the sale of shark fins by any commercial fisherman with a valid federal fishing license or dealer permit (2020 Fla. SB 680). Other states, such as Oregon, allow a daily catch limit of 25 fish in the aggregate per fisherman (*2021 Oregon Sport Regulations for Salmon, Halibut, and Other Marine*, Oregon Marine Resources).

Overall, the patchwork of state regulations affecting tope shark fails to adequately protect the species (Walker et al. 2020, at 1, 10). A listing under the ESA is needed to prevent the extinction of the tope shark.

Northeast Pacific - Canada

The tope shark was designated as a species of Special Concern by the Committee on the Status of Endangered Wildlife in Canada ("COSEWIC") in 2007 and listed under Canada's Species at Risk Act, Schedule 1 as Special Concern in 2009 (*Species List*, Government of Canada). Recent Canadian bycatch has averaged 0.5 t/year and 1.8 t/year since 2006 in the trawl and hook and line fisheries, respectively, with mandatory release since 2011 (Walker et al. 2020, at 9). These protections have been beneficial to the tope shark residing off the Canadian coast, as the total bycatch has significantly decreased, but the legislation does not ensure an international conservation effort.

Southeast Pacific

In the Southeast Pacific, the tope shark is considered to be an unimportant fishery product, so much of the catch is likely unreported (Walker et al. 2020, at 9). Additionally, there is no mention of tope in chondrichthyan species reported to the Food and Agriculture Organization of the United Nations (*Id.*). Regulatory mechanisms thus do not protect the species in this region.

Australasia

Tope was listed in Australia as Conservation Dependent in 2009 with the Environmental Protection and Biodiversity Conservation Act of 1999 ("EPBC Act") (FAO). This unique listing category of 'Conservation Dependent' allows otherwise endangered species to continue to be commercially traded (AU Government). This means that despite being listed under the EPBC Act, tope sharks can still be caught in Australian waters and sold in shops, fish markets, and restaurants, or exported, despite being considered threatened (*Id.*). Other management measures, such as the School Shark Rebuilding Strategy, aim to rebuild the Australasia stock to their limit reference point of 20 percent of unfished biomass within three-generation times (66 years) (Walker et al. 2020, at 10; *School Shark (Galeorhinus galeus) Stock Rebuilding Strategy*, at 2).

Some localized measures also have been implemented. In South Australia, conservation measures include requirements that all live-caught tope be released; limited entry for the use of gillnets and longlines; total allowable catch; gear restrictions; and permanent and seasonal closures for nursery and breeding areas (*Galeorhinus galeus*, Convention on the Conservation of Migratory Species of Wild Animals). Australian protection measures include protected areas and trip limits, yet annual catches are limited to 225 t of tope [approximately 4,955 individual female tope weighing 45.4 kg] per year (Walker et al. 2020, at 9). Despite some benefit afforded to the species by these measures, the protections enacted by Australia are overshadowed by New Zealand's lack of regulation (*Id.*).

In New Zealand, the Department of Conservation has listed the tope shark as 'Not Threatened' (Duffy et al. 2018, at 1). As such, tope is managed under the Quota Management System with Individual Transferable Quotas and is only subjected to a recreational bag limit of 20-30 fish per day (Walker et al. 2020, at 10). Catches continue to exceed 3,000 t annually [approximately 66,079 individual female tope weighing 45.4 kg] (*Id.*, at 9). In sum, regulatory measures for the Australasian stock of tope shark are insufficient to protect against the species' extinction.

E. Other Natural or Manmade Factors Affecting Continued Existence

The effects of pollution on Chondrichthyes species are understudied (Consales & Marsili, *Assessment of the Conservation Status of Chondrichthyans: Underestimation of the Pollution Threat*, at 165). However, as top predators in the food chain, sharks are prone to the accumulation of high levels of toxic pollutants (Kibria & Haroon 2015, at 1). Considering its reliance on near-shore breeding areas, toxicants pose serious threats to the tope shark throughout its range, and in California in particular, given excessive levels of DDT in and around important habitats (*See* O'Shea et al. 1999, at 18).

Dichloro-diphenyl-trichloroethane ("DDT") is a synthetic insecticide that was developed in the 1940s to combat disease in military and civilian populations and control insects in crop and livestock production (*DDT - A Brief History and Status*). After World War II, the use of DDT grew exponentially within agricultural and consumer markets (*Id.*). The discovery of this product's toxicity and persistence in the food chain inspired marine biologist Rachel Carson's famous book *Silent Spring* and a new public movement to ban pesticide products in favor of the environment and human health (*Id.*). While DDT is now prohibited in the United States, it is still used in some countries to combat Malaria (*DDT*, Persistent Organic Pollutants Toolkit). DDT and its byproducts are bioaccumulative insoluble in water, and persistent in the environment, and as a result are known to afflict many ocean species, including sharks, despite the ban (*Id.*).

High concentrations of DDT have been detected in ocean sediments off the coast of Southern California, a region that served as a historical dumpsite for industrial waste for several decades (*Montrose Chemical Corp. Torrance, CA*; MacGregor 1974, at 292). Barrels of DDT, discarded into the ocean off Southern California, have been leaking DDT, leading to a toxicity rate of ~40 times greater than the highest level of surface sediment contamination at the nearby DDT Superfund site (Kivenson et al. 2019, at 2971). Tope likely encounter concentrations of DDT and PCBs from other areas as well, such as the Palos Verdes Shelf Superfund Site and Santa Catalina Island (*Palos Verdes Shelf Superfund Site*, at 1). Detectable and toxic levels of DDT and PCB have been found in sharks off the coast of California at levels 100 and 250 times the acceptable limit for human consumption respectively (Kibria & Haroon 2015, at 5, 7; Lyons et al. 2015, at 7-9). Mercury was also present at levels 45 times greater than the consumption limit for women of childbearing age and children (Lyons et al. 2015, at 9).

Many marine species continue to be harmed by the legacy of this DDT contamination. In the Southern California bight, researchers found 45 DDT-related compounds in the blubber of common bottlenose dolphins (*Tursiops truncatus*), an apex predator (Mackintosh et al. 2016, at 9). Thus, it is reasonable to suspect that sharks, as well as other apex predators in the region, would likewise be affected by these pollutants.

Sharks position as an apex predator increases their exposure to contaminants that bioaccumulate and biomagnify up the food chain. In sharks, compounds like DDT are stored in the liver and passed from mother to her pups, leaving the pups plagued with DDT poisoning (Kibria & Haroon 2015, at 5, 7). Indeed, a "significant positive relationship [has been] found between [young of the year (YOY)] contaminant loads and maternal trophic position, suggesting that trophic ecology is one factor that plays an important role in maternal offloading" (Lyons et al. 2013, at 27). Since these toxic contaminants are already present in the oceans and persist for extended periods of time, DDT and PCBs represent both present and future threats to the tope shark (*See generally* Kivenson et al. 2019, at 2971).

In light of research on similar species, exposure to and bioaccumulation of DDT and other pollutants likely have played a role in the tope shark's decline. Studies have revealed elevated levels of both inorganic and organic micropollutants in sharks' muscle and liver, including heavy metals (e.g., mercury, cadmium, arsenic, lead) and various persistent organic pollutants (e.g.,

polychlorinated biphenyls (PCBs), polychlorinated dibenzo furans (PCDFs), polychlorinated dibenzo-p-dioxins (PCDDs), and pesticides, including DDT and hexachlorobenzene) (Kibria & Haroon 2015, at 1; Torres 2017). Adverse health effects in high trophic level species including sharks are associated with the exposure of persistent organic pollutants and dioxin-like compounds in particular (Ross & Birnbaum 2003, at 305).

Accumulation of these toxins may make shark species susceptible to long-term effects such as interference with secretions from the rectal gland, changes in heart function, changes in blood parameters, inhibition of DNA synthesis, disruption of sperm production, and death (*Id.*, at 10). Increased pollutant exposure leads to diminished appetite, lowered swimming activity, starvation, and even mortality (*Id.*). Exposure of marine animals including sharks to persistent organic pollutants (PCBs, DDT) may cause negative effects including birth defects, high infertility rates, endocrine disruption, and other reproductive problems (*Id.*). In addition to hindering reproductive success, sharks harboring high contaminant loads may be at risk of immune system dysfunction. Otherwise non-threatening diseases may pose an acute or chronic health risk due to sharks' immune systems operating at suboptimal levels. Warmer sea temperatures associated with climate change could trigger aggressive proliferation of bacteria, further exacerbating the threat of immunosuppression (Sawyna et al. 2017, at 49). In sum, contaminants appear to pose a risk to tope sharks, increasing their risk of extinction.

In addition, deformed snouts, caused by physical damage, congenital abnormality, or potential effects of environmental contaminants, have reportedly affected the tope shark (Quigley et al. 2014, at 139).

IV. Critical Habitat Designation

The ESA mandates that, when NMFS lists a species as endangered or threatened, the agency must also concurrently designate critical habitat for that species. 16 U.S.C. § 1533(a)(3)(A)(i); *see also id.* at § 1533(b)(6)(C); *see also Weyerhaeuser Co. v. United States Fish & Wildlife Serv.*, 139 S. Ct. 361 (2018) (stating that the ESA "directs the Secretary of the Interior, upon listing a species as endangered, to also designate the 'critical habitat' of the species.).

The ESA defines "critical habitat" as:

a. [T]he specific areas within the geographical area occupied by the species . . . on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and
b. [S]pecific areas outside the geographical area occupied by the species . . . upon a determination by the Secretary that such areas are essential for the conservation of the species."

Id. at § 1532(5)(A).

Petitioners expect that NMFS will comply with this unambiguous mandate and designate critical habitat concurrently with the listing of the tope shark. Critical habitat must include, but should not be limited to, the breeding habitat off the West Coast (Nosal et al. 2021).

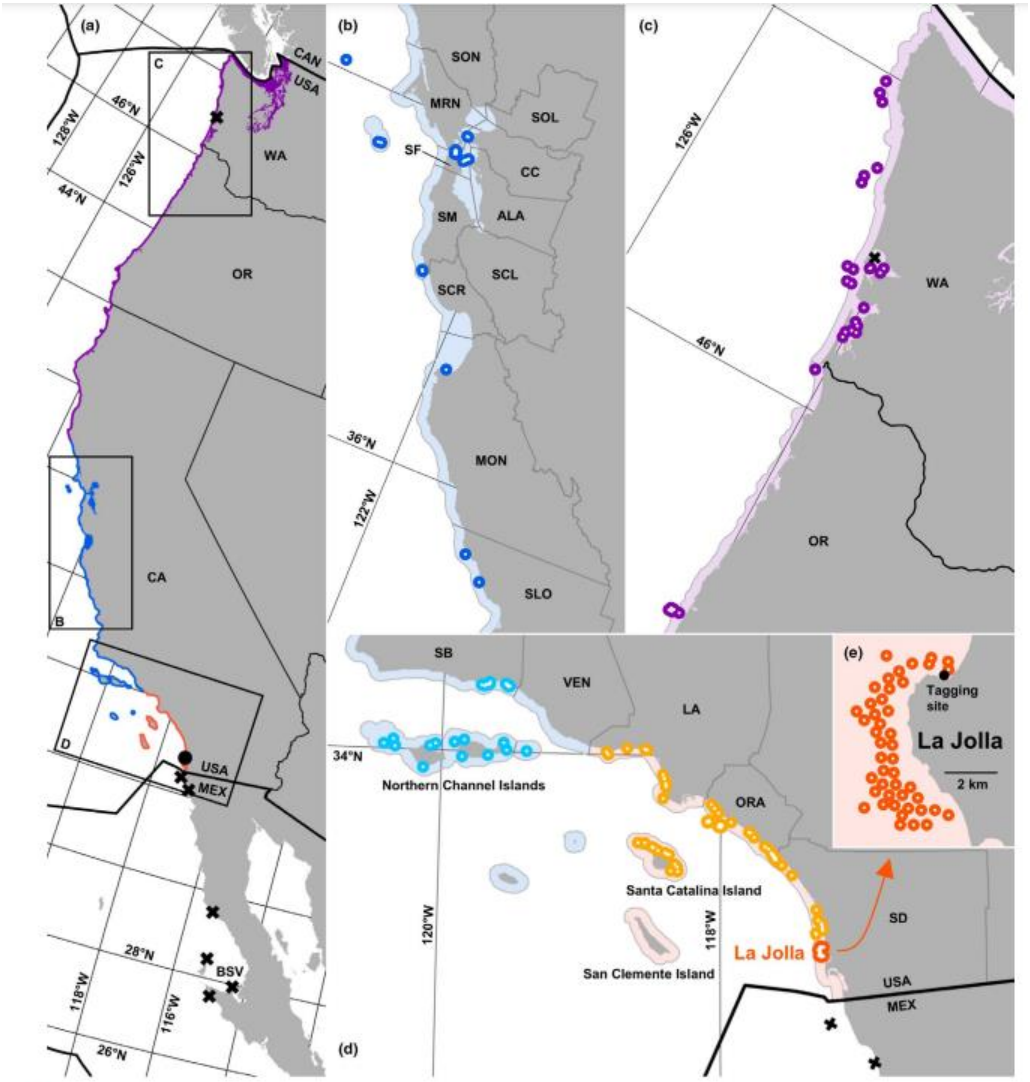


FIGURE 1 West coast of North America, where 34 adult female soupfin sharks *Galeorhinus galeus* were tracked by passive acoustic telemetry between 2013 and 2020 (a). Lines of latitude (°N) and longitude (°W) are given in 2-degree increments. US state waters (out to 5.6 km) are colour-coded by region, as defined by Ripley (1946). Southern California (CA) waters are coloured orange: San Diego (SD), Orange (ORA) and Los Angeles (LA) Counties; California Central Coast waters are coloured blue: Ventura (VEN), Santa Barbara (SB), San Luis Obispo (SLO), Monterey (MON), Santa Cruz (SCR), Santa Clara (SCL), San Mateo (SM), San Francisco (SF), Alameda (ALA), Contra Costa (CC), Solano (SOL), Marin (MRN) and Sonoma (SON) Counties; and Northern California (Mendocino, Humboldt and Del Norte Counties; not shown), Oregon (OR) and Washington (WA) waters are coloured purple. The black circle indicates the tagging site off La Jolla (San Diego County), CA. The locations of acoustic receivers that detected soupfin sharks are indicated by white dots with colour-coded halos by zone: 109 receivers off SLO through SON are haloed dark blue (b), 29 off OR and WA purple (c), 45 off La Jolla in SD dark orange (e), 121 off the rest of SD, ORA and LA light orange, and 33 off VEN and SB light blue (d). Black X's indicate recapture locations of tagged soupfin sharks (BSV = Bahía Sebastián Vizcaíno). Thin gray lines indicate CA county borders, medium black lines state borders and thick black lines international borders, including exclusive economic zones

Map of the Known Tope Critical Habitat along the West Coast (Nosal et al. 2020, at 1573).

V. 4(d) Rule

Should NMFS determine after conducting a status review that listing the tope shark as "threatened" is warranted, Petitioners request that the agency simultaneously issue a 4(d) rule outlining necessary and advisable regulations for the species' conservation. As part of this 4(d) rule and in light of the threat posed to the tope by trade, Petitioners urge NMFS to extend to the tope shark all prohibitions of ESA Section 9, including bans on taking, imports, exports, sale in interstate or foreign commerce, and transport (applying the existing limited exceptions to promote science and restoration as provided in ESA Section 10) and to promulgate additional protective regulations needed for survival and recovery of the tope shark.

VI. Conclusion

Overexploitation for fins, meat, and liver oil, bycatch, habitat degradation, inadequate regulatory mechanisms and other manmade factors, including contaminants, pose existential threats to the tope shark's continued existence. As such, the tope shark meets the criteria for listing under the ESA. Listing is essential to ensure the tope shark's survival and persistence.

Petitioners request the tope shark be listed as endangered under the ESA and request that NMFS designate critical habitat for the species within U.S. waters. Listing will significantly improve the species' conservation prospects by reducing key threats and by increasing global awareness, catalyzing additional research, and forging national and international conservation partnerships. Petitioners urge NMFS to grant the actions requested herein without delay.

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