Before the Secretary of Commerce

Petition to list the Smalltail Shark, *Carcharhinus porosus*, under the U.S. Endangered Species Act

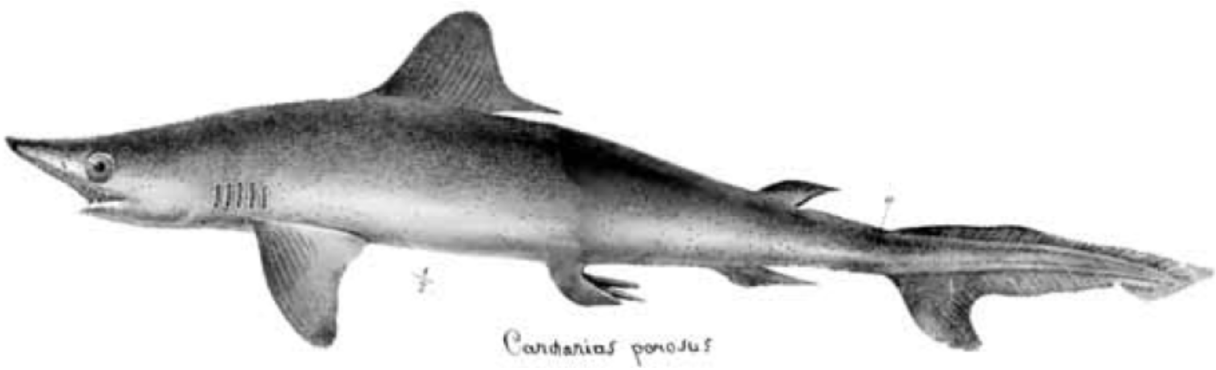

Illustration: Ranzani (1840)[1]

Center for Biological Diversity

October 31, 2022

[1] Ranzani, C., De novis speciebus piscium, 4 Novi Commentarii Academiae Scientiarum, Instituti Bononiensis 65 (1840)

Notice of Petition

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The Center for Biological Diversity (Center, Petitioner) submits to the Secretary of Commerce and the National Oceanographic and Atmospheric Administration (NOAA) through the National Marine Fisheries Service (NMFS) a petition to list the smalltail shark, *Carcharhinus porosus*, as threatened or endangered under the U.S. Endangered Species Act (ESA), 16 U.S.C. § 1531 *et seq*.

The Center is a non-profit, public interest environmental organization dedicated to the protection of native species and their habitats. The Center has more than 1.7 million members and online activists worldwide. The Center and its members seek to conserve imperiled species like the smalltail shark through science, policy, and effective implementation of the ESA.

NMFS has 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 need not demonstrate that the listing is warranted, but rather present information demonstrating that such action may be warranted. The Center believes the best available scientific information demonstrates that listing the smalltail shark as threatened or endangered throughout all or a significant portion of its range is warranted, and the available information clearly indicates that listing the species may be warranted. As such, 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).

Respectfully submitted this 31st day of October, 2022.

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Executive Summary

The global smalltail shark (*Carcharhinus porosus*) population has declined by > 80% over the past 27 years, with even greater declines (~90%) at the core of the species' distribution. This species is spiraling toward extinction and needs immediate protection. Accordingly, this petition seeks to list the smalltail shark as a threatened or endangered species under the U.S. Endangered Species Act.

Sharks, rays, and chimeras first evolved around 420 million years ago, and they have survived at least five mass extinctions.[2] Yet today, over one-third are threatened with global extinction.[3] Sharks represent one of the most severely threatened taxonomic groups in the world. Since the 1970s, global shark populations have declined by more than 70%. This endangerment largely is the result of overfishing driven by the multi-billion-dollar fin trade and increasing utilization of shark meat, which collectively result in the death of more than 100 million sharks per year. Fishing at this rate is unsustainable; indeed, at least three species of sharks and rays are believed to be extinct as the direct result of overexploitation.[4] One of these extinct species, *Carcharhinus obsolerus*, is closely related to smalltail sharks, highlighting the species' susceptibility to extinction.[5]

The 80 percent global population decline of the smalltail shark is driven largely by overfishing. The species is both targeted and caught as bycatch; its fins enter the global market and the meat is consumed locally. Regulation of shark fisheries in many regions is nonexistent or insufficient to protect the species.

As a tropical and subtropical species that inhabits shallow, coastal areas, the smalltail shark also is threatened by climate change, habitat degradation, and contaminant exposure. A suite of life history traits including longevity, slow growth, late age of sexual maturity, long gestation, low fertility and fecundity, low phenotypic plasticity, and high natural rates of mortality make sharks including the smalltail particularly vulnerable to overexploitation and slow to recover. These traits also make sharks vulnerable to rapid environmental change, impeding their adaptive capacity in the face of global climate change and other habitat modifications. Existing regulatory mechanisms fail to adequately protect the smalltail shark from sliding towards extinction.

The smalltail shark warrants listing under the U.S. Endangered Species Act (ESA) because it is in danger of extinction throughout all or a significant portion of its range. Recognizing this risk, the International Union for the Conservation of Nature (IUCN) listed the smalltail shark as Critically Endangered in 2020. Listing the smalltail shark under the ESA will protect the species within U.S. waters, prohibit the import or export of smalltail sharks and their parts to or from the United States, and aid international efforts to protect the species by providing financial and technical assistance for law enforcement and the development of conservation initiatives.

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[2] Dulvy, Nicholas K. et al., Overfishing drives over one-third of all sharks and rays toward a global extinction crisis, 31 Current Biology 4773, 4774 (2021).
[3] Id. at 4774.
[4] Id. at 4776.
[5] Id. at 4776; Santana, Francisco Marcante et al., From plentiful to critically endangered: demographic evidence of the artisanal fisheries impact on the smalltail shark (*Carcharhinus porosus*) from Northern Brazil, 15 PLoS ONE e0236146 2 (2020).

PART I. SPECIES ACCOUNT

1. Introduction and Species Description

A. Taxonomy

The accepted taxonomy of the smalltail shark, based on Ranzani (1840),[6] is:

Kingdom: Animalia
Phylum: Chordata
Class: Chondrichthyes
Subclass: Elasmobranchii
Order: Carcharhiniformes
Family:Carcharhinidae
Genus: Carcharhinus
Species: porosus[7]

The species synonymously is known as *Carcharias porosus* (Ranzani 1839)[8] and is considered district from *Carcharhinus cerdale*, which is restricted to the Eastern Pacific.[9] Molecular analysis confirms this distinction.[10]

B. Physiology, Morphology, and Behavior

The smalltail shark is a small (<150 cm total length) requiem shark that is grey on top and dirty white below.[11] The shark has large eyes and a long, pointed snout.[12] It is smooth-backed, lacking an interdorsal ridge, and its fins are unmarked.[13] It has a short gill openings and a deeply notched

[6] Ranzani, supra note 1.
[7] See Eschmeyer, W.N. et al. (eds.), Eschmeyer's Catalog of Fishes 2 (updated Sept. 7, 2022), available at https://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp; Pollum et al., R. et al., *Carcharhinus porosus*. The IUCN Red List of Threatened Species (2020), available at https://dx.doi.org/10.2305/IUCN.UK.2020-3.RLTS.T144136822A3094594.en .
[8] Pollum et al., supra note 7, at 1.
[9] Castro, J.I., Resurrection of the name *Carcharhinus cerdale*, a species different from *Carcharhinus porosus*, 17 Int'l J. Icthyology 1 (2011).
[10] See Naylor, G.J.P. et al., A DNA sequence-based approach to the identification of shark and ray species and its implications for global elasmobranch diversity and parasitology, 367 Bull. Am. Museum Natural History 1 (2012). Adults of *C. porosus* and *C. cerdale* are easy to differentiate morphologically, whereas juveniles have more similar proportional measurements. Castro, supra note 9, at 8. The species' oblique teeth likewise are similar, which may have caused confusion in the past. Id.
[11] Lessa, R. et al., Population structure and reproductive biology of the smalltail shark (*Carcharhinus porosus*) off Maranhão (Brazil), 50 Marine & Freshwater Research 383, 383 (1999); Pollum et al., supra note 7, at 1, 5, citing Weigmann, S., Annotated checklist of the living sharks, batoids and chimaeras (Chondrichthyes) of the world, with a focus on biogeographical diversity, 88 J. Fish Biology 837 (2016); Castro, supra note 9, at 8.
[12] Florida Museum, Discover Fishes: Carcharhinus porosus, at https://www.floridamuseum.ufl.edu/discover-fish/species-profiles/carcharhinus-porosus/.
[13] Castro, supra note 9, at 8.

anal fin.[14] The first dorsal fin originates over or behind the free rear tip of the pectoral fin.[15] The first dorsal fin measures ~8-9% of the shark's total length, and the anterior margin of this fin is equal in length to the distance from the apex to the free rear tip.[16] It is one of only two shark species (the other being the Atlantic sharpnose shark (*Rhizoprionodon terraenovae*)), where second dorsal fin is positioned posterior of the anal fin.[17] The second dorsal fin originates over the midpoint of the anal fin base.[18] The caudal fin measures ~25% of total length.[19] *See* Fig. 1.

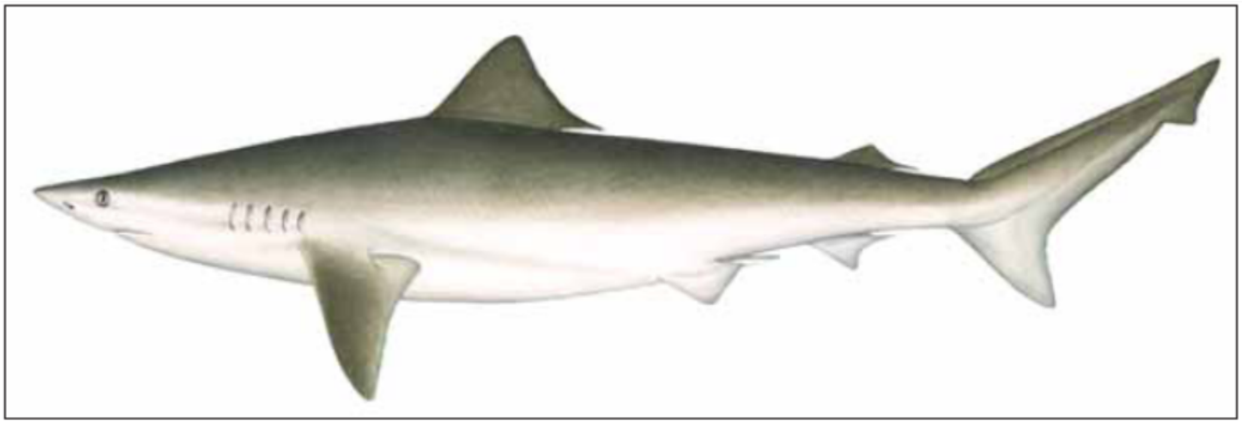

Fig. 5. *Carcharhinus porosus,* 86.3 cm TL adult male from Trinidad (from Castro, in press, used with permission).

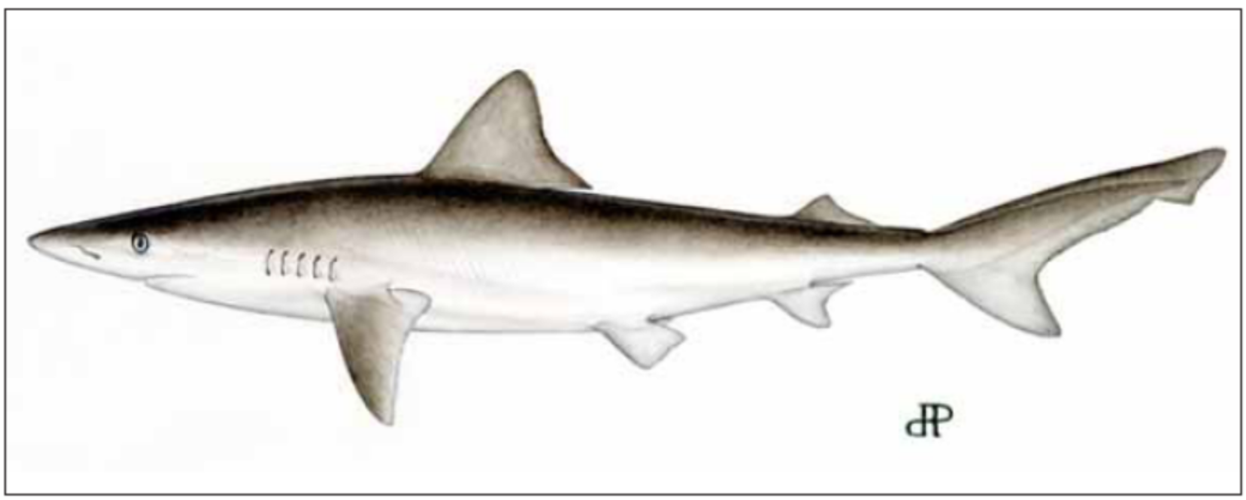

Fig. 6. *Carcharhinus porosus* neonate, 33.0 cm, 0.2 kg; from Bayou Goreau, Terrebonne Parish, Louisiana (TU 1896) (from Castro, in press used with permission).

Fig. 1. Illustrations of *Carcharhinus porosus* (Castrol 2011).[20]

[14] Florida Museum, supra note 12.
[15] Castro, supra note 9, at 8.
[16] Id.
[17] Id. at 5-9. See id. at 5, Table 1 (proportional measurements in percent of total length of the smalltail shark).
[18] Id. at 8.
[19] Id.
[20] Id. at 4, citing Castro, J.I., The Sharks of North America (2011).

Behind the eye, the smalltail shark has a series of conspicuous hyomandibular pores.[21] Characteristic dentition can be observed in Fig. 2, and a more detailed description found in Castrol (2011).

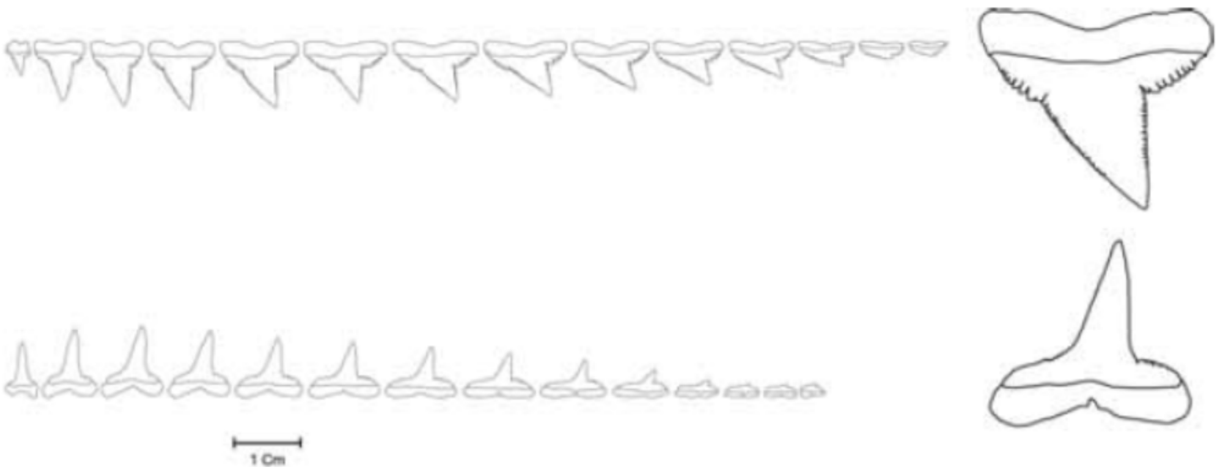

Fig. 2. Adult *Carcharhinus porosus* dentition (Castro 2011).[22]

Smalltail sharks have characteristic dermal denticles with a strong central ridge that ends in a long point.[23] Two shorter, wing-like ridges flank the center ridge.[24] The dorsal denticle surface features a coarse microstructure.[25] *See* Fig. 3.

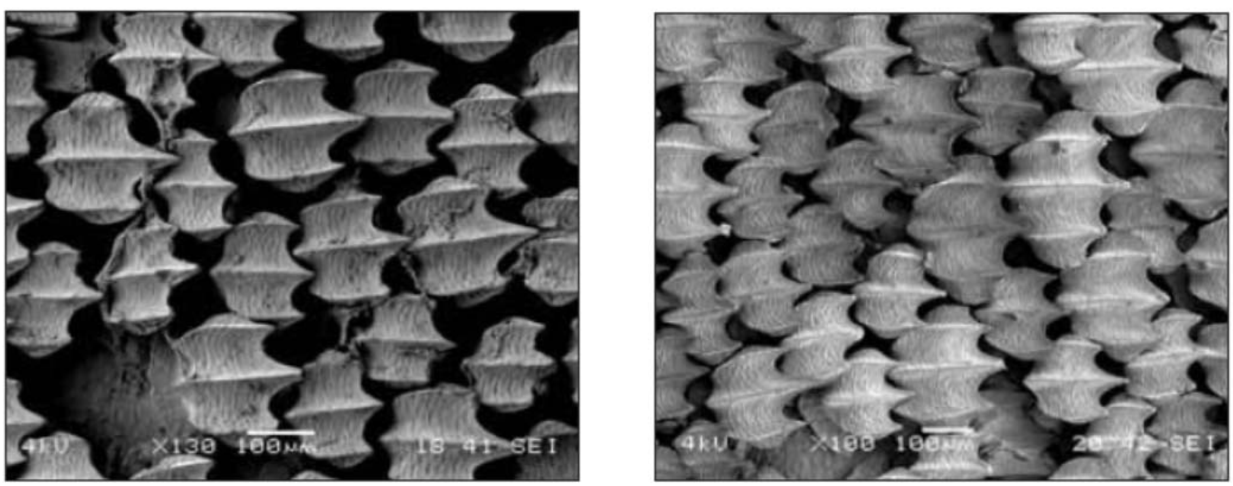

Fig. 3. Smalltail shark dermal denticles from adult (left) and neonate (right) (Castro 2011).[26]

[21] Castro, supra note 9, at 8.
[22] Id.at 6, Fig. 7, citing Castro, supra note 20.
[23] Castro, supra note 9, at 8.
[24] Id.
[25] Id.
[26] Id. at 6, Figs. 8-9, citing Castro, supra note 20.

The smalltail shark exhibits *K*-selected characteristics including slow growth, a long juvenile phase and resulting late maturity, and low fecundity.[27] Smalltail sharks mature at age six; males mature at 70 cm total length (TL) and females at 71 cm TL.[28] Like many other shark species, females tend to grow larger than males.[29]

Females give birth biannually to litters of two to nine pups (average six) after a 12-month gestation; reproduction is yolk-sac placental viviparous and pup size at birth is 31-40 cm TL.[30] In Brazil, copulation appears to occur in October with females resting from the previous year's gestation; birth occurs during the rainy season.[31] Maximum known age is 15 years for a male and 24 years for a female; generation length is estimated at ~eight or nine years.[32]

2. Distribution: Geographic and Biological Setting

The smalltail shark is an Atlantic coastal shark that historically ranged the central, western, and southern Gulf of Mexico and the Caribbean coast of Central and South America to Paraná, Brazil.[33] It presently is believed to occur in Belize, Brazil (Amapá, Maranhão, Pará), Colombia, Costa Rica, French Guiana, Guatemala, Guyana, Honduras, Mexico, Nicaragua, Panama, Suriname, the United States, and Venezuela.[34] *See* Fig. 4. Portions of the species' historic range where it may be extinct include the following regions in Brazil: Alagoas, Bahia, Ceará, Espírito Santo, Paraná, Pernambuco, Rio Grande do Norte, Rio Grande do Sul, Rio de Janeiro, Sergipe, and São Paulo.[35] While the IUCN map shows the species' U.S. range as restricted to the Gulf of Mexico (where occurrences have been recorded), *see* Fig. 4, modeling by Feitosa et al. (2020) reveals potentially suitable habitat along the U.S. east coast as well, *see* Fig. 5.[36] Due to their small size, smalltail sharks appear to have a restricted ability to disperse.[37]

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[27] Lessa et al., supra note 11, at 388; Lessa, Rosangela & Francisco Marcante Santana, Age determination and growth of the smalltail shark, *Carcharhinus porosus*, from northern Brazil, 49 Marine Freshwater Res. 705, 710 (1998); Feitosa, L.M. et al., Potential distribution and population trends of the smalltail shark *Carcharhinus porosus* inferred from species distribution models and historical catch data, 30 Aquatic Conservation: Marine & Freshwater Systems 882, 888 (2020); Santana et al., supra note 5, at 10. Santana et al. estimate generation time at 7.9 years. Id. See also Cortés, Enric, Incorporating uncertainty into demographic modeling: application to shark populations and their conservation, 16 Conservation Biology 1048, 1062 (2002) (estimating generation length as 8.4 years, with a range of 7.5 – 9.6 years).

[28] Pollum et al., supra note 7, at 5, citing Lessa & Santana, supra note 27. One hundred percent of sharks were mature at 75.0 cm. Lessa et al., supra note 11, at 384.

[29] Lessa et al., supra note 11, at 386

[30] Pollum et al., supra note 7, at 5, citing Lessa et al., supra note 11. See also Lessa & Santana, supra note 27, at 709; Lessa et al., supra note 11, at 383, 387; Feitosa et al., supra note 27, at 883; Feitosa, Leonardo Manir, Valderi Dressler & Rosangela Paula Lessa, Habitat use patterns and identification of essential habitat for an endangered coastal shark with vertebrae microchemistry: the case study of *Carcharhinus porosus*, 7 Frontiers Marine Sci. 125, at 2 (2020).

[31] Feitosa, Dressler & Lessa, supra note 30, at 8.

[32] Pollum et al., supra note 7, at 5, Lessa & Santana, supra note 27, at 708; Santana et al., supra note 5.

[33] Pollum et al., supra note 7, at 1, citing Ebert, D.A. et al., Sharks of the World (2013). It did not inhabit the Caribbean Islands. Pollum et al., supra note 7, at 1, citing Ebert et al.

[34] Pollum et al., supra note 7, at 2.

[35] Id. See also Santana et al., supra note 5.

[36] Feitosa et al., supra note 27, at 886.

[37] Feitosa, Dressler & Lessa, supra note 30, at 9.

Fig. 4. Geographic range map of the smalltail shark from Pollum *et al*. (2020).

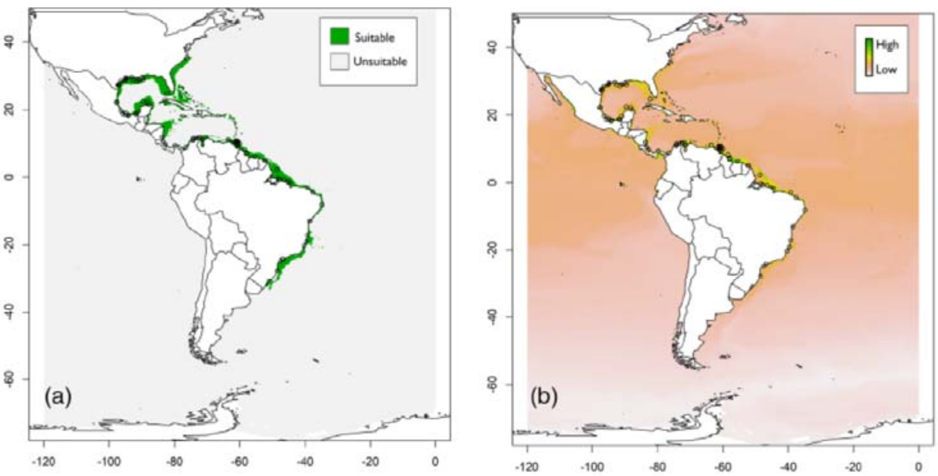

FIGURE 1 Prediction of *Carcharhinus porosus* distribution using an ensemble approach with four distinct algorithms (BIOCLIM, Domain, Mahalanobis and Maxent). (a) Predicted distribution based on a habitat suitability threshold; (b) habitat suitability levels. Dots represent occurrence records

Fig. 5. Predicted smalltail shark distribution based on habitat suitability models (Feitosa et al. (2020) at 886.)

3. Abundance and Population Trends

Decreasing catch probabilities across the smalltail shark's range reflect the species' rapid and precipitous decline.[38]

Between 1970-2015, catch probability decreased across the species' entire range, with particularly dramatic declines in the Gulf of Mexico and South America.[39] Rangewide, the smalltail shark population size is believed to have decreased by > 80% over three generation lengths (27 years) and the trend is downward.[40] The smalltail shark's decline is inferred from documented declines in several portions of the species' range; decreasing probability of catch; lack of recent records across much of the species' range; substantial declines in other elasmobranch species across the species' range; and the unmanaged yet intensive fisheries present in this region.[41]

A. Western Central Atlantic

The IUCN estimates that the smalltail shark has undergone a population reduction of 50-79% in the Western Central Atlantic over the past three generation lengths (27 years).[42] This estimate is based on documented catch declines in certain areas alongside a lack of fisheries management across much of the region.[43]

[38] See Feitosa et al., supra note 27, at 886.
[39] Pollum et al., supra note 7, at 4.
[40] Id. at 2, 5.
[41] Id. at 4-5
[42] Id. at 4.
[43] Id.

United States Gulf of Mexico: The United States currently sits at the northern edge of the smalltail shark's range and data on population and trend are limited.[44] An overall decline in shark populations in the Gulf of Mexico was observed by Baum & Myers (2004).[45] According to Feitosa et al. (2020), calculated catch probabilities for the smalltail shark are below 50% of those from the 1970s with an ongoing declining trend.[46]

Southern Gulf of Mexico: The smalltail shark historically was abundant in the southern Gulf of Mexico across Yucatan, Campeche, and Tabasco states.[47] Beginning in the 2000s, landings became fewer and were concentrated in Tabasco.[48] Only 52 individuals were recorded caught in intensive surveys on the Yucatan shelf between 2011-2013 (all in Tabasco).[49] Between 2011-2014, *C. porosus* made up 0.18% of recorded shark catches in Mexico.[50] *C. porosus* continues to suffer mortality in bottom longline, vertical line, and shark-specific longline fisheries in the southern Gulf of Mexico.[51]

Caribbean: Caribbean data are limited.[52]

The smalltail shark is known to inhabit the Mexican Caribbean.[53]

No baseline data exist in Caribbean Colombia, where the smalltail shark is rare.[54] It currently makes up 8% of sharks caught in the country.[55]

In Venezuela, landings have declined in recent years after variable catch rates between 2007-2015.[56]

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[44] Id., citing Carlson, J.K. 2020 (unpublished data).
[45] Baum, Julia K. & Ransom A. Myers, Shifting baselines and the decline of pelagic sharks in the Gulf of Mexico, 7 Ecology Letters 135 (2004).
[46] Feitosa et al., supra note 27, at 887.
[47] Pollum et al., supra note 7, at 4, citing Pérez-Jiménez, J.C. 2019 (unpublished data).
[48] Pollum et al., supra note 7, at 4, citing Pérez-Jiménez, J.C. et al., Análisis histórico de las pesquerías de elasmobranquios del sureste del golfo de México, in Sánchez, A.J. et al. (eds), Rescursos acuáticos costeros del sureste (2012).
[49] Pollum et al., supra note 7, at 4, citing Pérez-Jiménez, J.C. & I. Méndez-Loeza, The small-scale shark fisheries in the southern Gulf of Mexico: understanding their heterogeneity to improve their management, 172 Fisheries Research 96 (2015).
[50] Feitosa et al., supra note 27, at 888-889.
[51] Pérez-Jiménez, Juan Carlos et al., Shark-catch composition and seasonality in the data-poor small-scale fisheries of the southern Gulf of Mexico, 71 Marine & Freshwater Research 1182, 1185-86 (2020).
[52] Pollum et al., supra note 7, at 4.
[53] Blanco-Parra, María del Pilar & Carlos Alberto Niño-Torres, Elasmobranchs of the Mexican Caribbean: biodiversity and conservation status, 105 Environmental Biology Fishes 151, 156 (2022); Blanco-Parra, María del Pilar & Carlos Alberto Niño-Torres, Correction to: Elasmobranchs of the Mexican Caribbean: biodiversity and conservation status, 105 Environmental Biology Fishes 345 (2022).
[54] Pollum et al., supra note 7, at 4, citing Mejía-Falla, P. 2019 (unpublished data). See also Mejía-Falla, Paola A. & Andrés Felipe Navia, Checklist of marine elasmobranchs of Colombia, 24 Univ. Sci. 241 (2019) (confirming C. porosus as present in the Colombian Caribbean through both museum specimens and fishery data).
[55] Feitosa et al., supra note 27, at 889.
[56] Pollum et al., supra note 7, at 4, citing Lasso, O. 2018 (unpublished data).

The Guianas lack sufficient data overall, though the smalltail shark accounts for 17.4% of sharks caught by Guyana's artisanal fisheries.[57] In 2015, it was the second most caught species in Guyana.[58]

Castro (2011) found the smalltail shark to be relatively abundant off Trinidad.[59]

B. Brazil

Northern Brazil: Studies carried out on Brazil's northern coast in the 1980s and 1990s provide a critical data set for smalltail shark trends.[60] Smalltail shark was, for a time, the most commonly caught elasmobranch species in shrimp (*Farfantepenaeus subtilis*) trawl fisheries as well as gillnet fisheries targeting Brazilian Spanish mackerel (*Scomberomorus brasiliensis*) and Acoupa weakfish (*Cynoscion acoupa*) at depths of 50-80 m off Amapá, Pará, and Maranhão states.[61] Other gear types known to capture smalltail sharks include longlines, purse seine nets, and beach seine nets.[62] Incidentally caught smalltail sharks are retained in all of these fisheries, and other fishers intentionally target the species.[63]

Shrimp trawl fisheries pull in a significant amount of bycatch, including elasmobranch species.[64] Sharks constituted 35.1% of bycatch in the shrimp trawl fishery in the early 2000s; while this catch was known to include *C. porosus*, species-level catch data do not exist.[65]

During the 1980s and 1990s, the smalltail shark was the most abundant shark species caught in Brazil north coast drift gillnet fisheries, accounting for up to 70% of total catch by weight and 43% by number of elasmobranch individuals in the 1980s; juveniles accounted for 80% of that catch.[66] Smalltail sharks currently comprise 9.8% of sharks caught on Brazil's northern coast.[67]

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[57] Pollum et al., supra note 7, at 4; Feitosa et al., supra note 27, at 889, citing Kolmann, M.A. et al., DNA barcoding reveals the diversity of sharks in Guyana coastal markets, 15 Neotropical Icthyology e170097 (2017).
[58] Feitosa, L.M. et al., DNA-based identification reveals illegal trade of threatened shark species in a global elasmobranch conservation hotspot, 8 Nature Sci. Reports 3347, at 6 (2018), citing Kolmann et al., supra note 57
[59] Castro, supra note 9, at 8-9.
[60] Feitosa et al., supra note 27, at 883.
[61] Pollum et al., supra note 7, at 4, citing Marceniuk, Alexandre Pires et al., Sharks and batoids (subclass Elasmobranchii) caught in the industrial fisheries off the Brazilian North Coast, 27 Revista Nordestina de Biologia 120, 122 (2019); Santana et al., supra note 5, at 2; Rodrigues-Filho, L.F.S. et al., Identification and phylogenetic inferences on stocks of sharks affected by the fishing industry off the Northern coast of Brazil, 32 Genetics & Molecular Biology 405, 406 (2009); Feitosa et al., supra note 27, at 888. The gillnet fisheries targeted depth ranges of 5-20 m, while the trawl fishery targeted 20-50 m in depth. Id.; Feitosa, Dressler & Lessa, supra note 30, at 2; Feitosa et al., supra note 58, at 5; Lessa et al., supra note 11, at 383; Santana et al., supra note 5, at 3.
[62] Marceniuk et al., supra note 61, at 122.
[63] Rodrigues-Filho et al., supra note 61, at 406.
[64] See generally Shepherd, Travis D. & Ransom Myers, Direct and indirect fishery effects on small coastal elasmobranchs in the northern Gulf of Mexico, 8 Ecology Letters 1095 (2005).
[65] Santana et al., supra note 5, at 3.
[66] Feitosa et al., supra note 58, at 6, citing Lessa, R.P.T., Sinopse dos estudos sobre elasmobrânquios da costa do Maranhão, 10 Bloetim do Laboratório de Hidrobiologia 19 (1997); Lessa et al., supra note 11, at 383; Feitosa et al., supra note 27, at 883, 888; Pollum et al., supra note 7, at 4; Santana et al., supra note 5, at 3.
[67] Feitosa et al., supra note 27, at 889.

A threefold decline in catch rates from 2.87 kg/hr in 1990 to 0.43 kg/hr in the early 2000s (despite increased effort) equates to an 85% population reduction rate over three generations (27 years).[68] No recovery has since been observed.[69] In Maranhão state, smalltail shark went from being the most commonly landed shark in the 1980s to rare; scientists estimate the species has experienced a 90% population decline there over three generation lengths.[70] Catch also has declined precipitously in the Bragança region and areas of northern Brazil have experienced local extinctions.[71] Over the entire core distribution, demographic modeling estimates a population reduction of over 90% over three generations as a consequence of fishing mortality exceeding population growth rates.[72]

Eastern & Southern Brazil: In Eastern South America, the smalltail shark has experienced a nearly linear declining trend leading to a threefold decline from the 1970s to the 2010s.[73] The smalltail shark was common in Eastern and Southern Brazil in the 1970s and 1980s.[74] This is no longer the case, with the species having undergone a drastic range contraction.[75] It is believed the smalltail shark has disappeared from at least 11 Brazilian states: Alagoas, Bahia, Ceará, Espírito Santo, Paraná, Pernambuco, Rio Grande do Norte, Rio Grande do Sul, Rio de Janeiro, Sergipe, and São Paulo.[76] Smalltail sharks have not been recorded in over 15 years from this entire region, stretching from Ceará in the northeast to Paraná in the southeeast.[77] The last recorded smalltail shark from Ceará was in 1986 and from Paraná in the late 1990s.[78] Eighteen individuals were recorded caught between 1990-2002 in São Paulo.[79]

C. Summary

Decreasing catch probabilities across the Western Central Atlantic and in Brazil underscore the smalltail shark's rapid and precipitous decline—a decline of over 80% over the past three generations.[80] The downward trend continues, largely due to relentless fishing pressure.[81] Fisheries in the heart of the species range are intensive yet largely unmanaged, *see* Parts III.2, III.4, *infra*, placing the smalltail shark at risk of imminent extinction.[82]

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[68] Santana et al., supra note 5, at 3, 15; Feitosa et al., supra note 58; Feitosa et al., supra note 27, at 883, 888.
[69] Feitosa et al., supra note 27, at 883, 888.
[70] Pollum et al., supra note 7, at 4, citing Lessa, R. 2020 (unpublished data), Santana, F.M. 2018 (unpublished data); Santana et al., supra note 5, at 2.
[71] See Martins et al., supra note 123, at 7.
[72] Pollum et al., supra note 7, at 4, citing Santana et al., supra note 5.
[73] Feitosa et al., supra note 27, at 887.
[74] Pollum et al., supra note 7, at 4.
[75] Santana et al., supra note 5, at 2.
[76] Pollum et al., supra note 7, at 4, citing Charvet, P. & F.M. Santana 2020 (unpublished data). See also Feitosa et al., supra note 27, at 889 (noting that no C. porosus have been caught in Pernambuco state since 1994).
[77] Pollum et al., supra note 7, at 4.
[78] Id., citing Motta, F. 2018 (unpublished data), Rincon, G. 2018 (unpublished data).
[79] Pollum et al., supra note 7, at 4, citing Motta, F. 2018 (unpublished data).
[80] See Feitosa et al., supra note 27, at 886; Pollum et al., supra note 7, at 2, 4, 5.
[81] Id. at 2, 5.
[82] Id. at 4-5

4. Habitat Use

The smalltail shark inhabits shallower (<84 m), dynamic, muddy inshore areas and estuaries along the continental shelf in warm tropical and subtropical waters.[83] The highly turbid and productive waters off the northern coast of South America, including Venezuela and Brazil, serve as an essential habitat for the species.[84]

Variables most strongly associated with the smalltail shark's distribution include seawater temperature, light at the bottom (a proxy for turbidity), and dissolved oxygen.[85] The species is highly associated with coastal areas rich in mangrove forests (especially those comprised of *Rhizophora mangle* and *Avicennia germinans*);[86] the IUCN characterizes these areas as essential habitat for smalltail sharks.[87] While sharks often use estuaries as grounds for feeding, mating, gestation, and parturition,[88] smalltail sharks do not appear to have specific nursery areas.[89] That said, evidence "point[s] toward the existence of reused birthing grounds and possible philopatric behavior."[90]

Feitosa, Dressler & Lessa (2020) used vertebrae microchemistry to discern habitat use patterns for smalltail sharks.[91] They found that smalltail sharks do not appear to partition habitats throughout their lives; instead, all life stages consistently use an entire area.[92] Habitat data likewise indicate that smalltail sharks appear to use highly suitable habitat (*e.g*., along the Amazon coast)[93] during all life stages.[94] The species does, however, appear to segregate by sex.[95]

Off the coast of Texas, smalltail sharks have been recorded in Corpus Christi Bay.[96] Temperate and subtropical estuaries in this area are enclosed by a chain of barrier islands and contain oyster

[83] Pollum et al., supra note 7, at 1, citing Ebert et al., supra note 33, Weigmann, supra note 11; Santana et al., supra note 5; Feitosa et al., supra note 27, at 888; Feitosa, Dressler & Lessa, supra note 30, at 2. Santana et al., supra note 5, report that coastal and estuarine waters off Brazil's north coast may be a communal nursery area for elasmobranchs. See also Marceniuk et al., supra note 61, at 122 (noting that Pará State may be a nursery area, and is also an area of increasing fishing interest); Feitosa, Dressler & Lessa, supra note 30, at 7; Swift, Dominic G. & David S. Portnoy, Identification and delineation of essential habitat for Elasmobranchs in estuaries on the Texas coast, 44 Estuaries & Coasts 788, 794 (2021).
[84] Leopold, M., Poissons de Mer de Guyane: Guide Illustre (2004); Santana et al., supra note 5, at 15; Feitosa et al., supra note 27, at 883, 888; Feitosa, Dressler & Lessa, supra note 30, at 8.
[85] Feitosa et al., supra note 27, at 885.
[86] Id. at 888; Feitosa, Dressler & Lessa, supra note 30, at 7.
[87] Pollum et al., supra note 7, at 5, citing Feitosa et al., supra note 27.
[88] Swift & Portnoy, supra note 83, at 788; Feitosa et al., supra note 27, at 886.
[89] Feitosa, Dressler & Lessa, supra note 30, at 8.
[90] Id.
[91] See generally id.
[92] Id. at 6, 8.
[93] While this area is likely the most important for *C. porosus* throughout its distributional range, it also is the area where fisheries pressure is the highest, posing a significant conservation threat (see discussion infra Parts I.6, III.2]). Santana et al., supra note 5, at 15.
[94] Santana et al., supra note 5, at 15; Feitosa et al., supra note 27, at 886.
[95] Feitosa, Dressler & Lessa, supra note 30, at 6, 8. But see id. (noting that fishing gear might have influenced catch patterns and the authors' conclusions). See also Santana et al., supra note 5, at 15.
[96] Swift & Portnoy, supra note 83, at 791, 792 (Table 1).

reef, seagrass, and marsh habitats.[97] Environmental parameters for a juvenile smalltail shark caught by Swift & Portnoy (2021) in Corpus Christi Bay are as follows (Fig. 6):

Table 4 Mean (± standard error) environmental conditions at which each species was caught

Species	S.Temp. (°C)	B.Temp. (°C)	S.Sal.	B.Sal.	S.DO (mg L^{-1})	B.DO (mg L^{-1})	Dist. (km)	Depth (m)
Carcharhinus porosus	29.5 ± NA	29.5 ± NA	24.0 ± NA	32.4 ± NA	NA	NA	29.3 ± NA	4.40 ± NA

S.Temp., surface temperature; *B.Temp.*, bottom temperature; *S.Sal.*, surface salinity; *B.Sal*, bottom salinity; *S.DO*, surface dissolved oxygen; *B.DO*, bottom dissolved oxygen; *Dist.*, distance from tidal inlet

Fig. 6. Environmental parameters for juvenile *Carcharhinus porosus* caught in Corpus Christi Bay, Texas (Swift & Portnoy 2021).[98]

Swift & Portnoy (2021) postulate that the preponderance of young-of-the-year ("YOY") and juvenile elasmobranchs found in Corpus Christi Bay could be due to its refuge characteristics.[99] More specifically, "[m]oderately deep habitats farther from areas that potential predators (i.e., adults of large coastal shark species) are likely to inhabit could provide better refuge for YOY and juvenile sharks, and this likely explains the greater abundance of these smaller individuals (i.e., YOY/juveniles of large coastal shark species) caught in Corpus Christi Bay."[100] They describe how Texas Coast estuarine habitat may be essential for several elasmobranch species including *C. porosus*.[101]

5. Diet and Feeding Ecology

Smalltail sharks are opportunistic predators that preferentially consume small teleost fish, but also consume molluscs and crustaceans.[102] In Brazil, stomach content analysis revealed the croakers (Sciaenidae) *Macrodon ancylodon* and *Stellifer naso* as primary prey species.[103]

Ontogenetic diet differences present in both sexes.[104] Juveniles appear to consume a wider variety of prey species and adults sometimes consume elasmobranchs.[105] Larger sharks tend to consumer larger (but not necessarily more) prey items.[106] Smalltail sharks appear to eat intermittently.[107]

[97] Id. at 789.
[98] Id. at 794 (Table 4).
[99] Id. at 796.
[100] Id. at 796; see also id. at 797.
[101] Id. at 797.
[102] Lessa, Rosangela & Zafira Almeida, Analysis of stomach contents of the smalltail shark *Carcharhinus porosus* from northern Brazil, 21 Cybum 123, 123, 126, 130 (1997); Feitosa, Dressler & Lessa, supra note 30, at 8.
[103] Lessa & Almeida, supra note 102, at 123, 126.
[104] Id. at 123.
[105] Id. at 123, 126.
[106] Id. at 132.
[107] Id. at 132.

6. Causes of Mortality

The primary cause of natural mortality (not related to old age) for smalltail sharks is predation by larger sharks.[108] Elasmobranchs, including smalltail sharks, suffer high levels of anthropogenic mortality from a variety of causes. Indeed, anthropogenic threats are the most significant threats for shark species, leading many of them to be threatened with extinction.[109] The primary cause of anthropogenic mortality is fishing: both targeted catch and incidental catch (*i.e.*, bycatch).[110]

Over 99% of shark species assessed by Dulvy et al. (2021) were threatened by overfishing.[111] It is the main threat for all shark species threatened with extinction and the sole threat for two-thirds of them.[112] Bycatch represents the majority of shark catch, and most incidentally caught sharks (including requiem sharks) are retained for food (meat, fins, livers), animal feed, skins (used for fashion accessories), oil (used in pharmaceuticals), biodiesel, jaws, cartilage, and other byproducts.[113] For incidentally caught sharks that are discarded, some mortality inevitably results.[114]

Sharks and rays suffered an initial peak of targeted capture in the 1930s and 1940s, when they were caught for their vitamin A-rich livers.[115] Since 1950, global shark catch reported to the Food and Agriculture Organization (FAO) has tripled, nearing one million tons.[116] Worm *et al.* (2013) estimated total global catch and mortality (to include both reported and unreported catch, finning, and discards) at 1.4 million metric tons for the years 2000 and 2010.[117] This means approximately 100 million sharks—and perhaps up to 273 million sharks—are being killed in fisheries annually.[118]

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[108] See, e.g., id.; Florida Museum, supra note 12.
[109] Rodrigues-Filho et al., supra note 61, at 405.
[110] Cruz, Marcelo Merten et al., Biodiversity on sale: the shark meat market threatens elasmobranchs in Brazil, 31 Aquatic Conservation: Marine & Freshwater Ecosystems 3437, 3438 (2021). See also Marceniuk et al., supra note 61.
[111] Dulvy et al., supra note 2, at 4776. See also Pacoureau, Nathan et al., Half a century of global decline in oceanic sharks and rays, 589 Nature 567, 567 (2021) (finding that, "since 1970, the global abundance of oceanic sharks and rays has declined by 71% owing to an 18-fold increase in relative fishing pressure," a depletion that "has increased the global extinction risk to the point at which three-quarters of the species comprising this functionally important assemblage are threatened with extinction").
[112] Id.
[113] Id. at 4776, 4778; Wosnick, Natascha et al., Does legislation affect elasmobranch conservation and research in Brazil? A case study from Paraná State, 27 Revista Nordestina de Biologia 158, 158 (2019); Pollum et al., supra note 7, at 5, citing Ebert et al., supra note 33; Rodrigues-Filho et al., supra note 61, at 405; Liu, Celine J.N. et al., Sharks in hot soup: DNA barcoding of shark species traded in Singapore, 241 Fisheries Research 105994, at 1 (2021), citing Cardeñosa, Diego, Genetic identification of threatened shark species in pet food and beauty care products, 20 Conservation Genetics 1383 (2019); Cruz et al., supra note 110, at 3438.
[114] Dulvy et al., supra note 2, at 4778. Bycatch mortality rates for chondrichthyans are high; in Brazil, the northeastern region has the highest rates of elasmobranch bycatch. Stevens, J.D. et al., The effects of fishing on sharks, rays, and chimaeras (chondrichthyans), and the implications for marine ecosystems, 57 ICES J. Marine Sci. 476, 476 (2000); Feitosa et al., supra note 58, at 2.
[115] Wosnick et al., supra note 113, at 158.
[116] Food and Agriculture Organization of the United Nations, The state of world fisheries and aquaculture 2018: meeting the sustainable development goals (2018).
[117] Worm, Boris et al., Global catches exploitation rates, and rebuilding options for sharks, 40 Marine Policy 194, 194 (2013).
[118] Id.

The shark fin trade is a major driver of this mortality, though shark meat also is becoming more commodified in Brazil and other countries like Trinidad and Tobago.[119] In fact, Brazil now ranks as one of the top elasmobranch fishing nations and potentially is the world's largest shark meat importer (importing from the United States, among other countries).[120]

Both commercial trawl fisheries and artisanal gillnet fisheries capture smalltail sharks across the species' range, though accurate and reliable data on the harvest do not exist and what data does exist is a considerable underestimate.[121] One of the primary challenges in determining fishery-related shark mortality is that sharks often are rendered unidentifiable prior to their sale.[122] Morphological identification of sharks post-harvest is difficult because sharks often are dismembered on board: fins are removed, heads and entrails are dumped overboard.[123] Molecular identification techniques have proven necessary to identify species catch composition because of these challenges as well as the fact that "[t]he identification of specimens by fishermen and fishmongers [bears] little relationship to their taxonomic classification."[124]

In addition to killing sharks directly, widespread fishing for other species has the secondary effect of depleting sharks' food resources.[125] This, in turn, makes sharks more vulnerable to other stressors.[126]

7. Conservation Status

In 2020, the smalltail shark was classified as "Critically Endangered" by the International Union for Conservation of Nature (IUCN).[127] The IUCN Red List, established in 1964, is "the world's

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[119] Cruz et al., supra note 110, at 3438; Rodrigues-Filho et al., supra note 61, at 405; Mohammed, Azad & Terry Mohammed, Mercury, arsenic, cadmium and lead in two commercial shark species (*Sphyrna lewini* and *Caraharinus porosus*) in Trinidad and Tobago, 119 Marine Pollution Bull. 214, 215 (2017); Feitosa et al., supra note 27, at 888, citing Martins, A.P.B. et al., Analysis of the supply chain and conservation status of sharks (Elasmobranchii: Superorder Selachimorpha) based on fisher knowledge, 13 PLoS ONE 1 (2018); Dulvy, N.K. et al., Extinction risk and conservation of the world's sharks and rays, 3 eLife e00590 (2014); Feitosa et al., supra note 58; Marceniuk et al., supra note 61, at 122. Castro (2011) report that the smalltail shark (or puppy shark, as it is locally known) is popular with consumers in Trinidad. Castro, supra note 9, at 9. Pollum et al., supra note 7, at 1.
[120] Feitosa et al., supra note 58, at 2; Wosnick et al., supra note 113, at 160.
[121] Rodrigues-Filho et al., supra note 61, at 406.
[122] Cruz et al., supra note 110, at 3438; Cardeñosa, D. et al., Small fins, large trade: a snapshot of the species composition of low-value shark fins in the Hong Kong markets, 23 Animal Conservation 203, 204 (2019).
[123] Martins, Thais et al., Intensive commercialization of endangered sharks and rays (Elasmobranchii) along the coastal Amazon as revealed by DNA barcode, 8 Frontiers Marine Sci. 769908 (2021); Wosnick, Natascha et al., Negative metal bioaccumulation impacts on systemic shark health and homeostatic balance, 168 Marine Pollution Bull. 112398 at 1, 9 (2021); Santana et al., supra note 5, at 14; Rodrigues-Filho et al., supra note 61, at 406; Liu et al., supra note 113, at 2. Dried fins are nearly impossible to identify without the aid of DNA identification techniques. Id.
[124] Rodrigues-Filho et al., supra note 61, at 409. See also Cardeñosa, Diego et al., Species composition of the largest shark fin retail-market in mainland China, 10 Nature Sci. Reports 12914 (2020) (noting that "[m]ost global shark catch and trade data are aggregated, unreported, or misidentified at the species level, hampering species-specific management and product traceability throughout supply chains").
[125] Cruz et al., supra note 110, at 3438.
[126] Id.
[127] See generally Pollum et al., supra note 7.

most comprehensive information source on the global conservation status of animal, fungi and plant species."[128] The list is "a powerful tool to inform and catalyze action for biodiversity conservation and policy change"[129] and is "widely accepted as the most objective and authoritative system available for assessing the global risk of extinction for species."[130] A species is listed as "Critically Endangered" when, based on the best available science, that species faces an "extremely high risk of extinction in the wild" based on an analysis of five factors: (A) population reduction, (B) restricted geographic range, (C) small population size and decline, (D) very small or restricted population, and/or (E) extinction probability analysis.[131] The Red List's "value derives from the implementation of a data-driven protocol, which leads to consistent classifications, as well as the compilation of a wealth of supporting data."[132] The IUCN's recent and comprehensive analysis of the smalltail shark under these five criteria and its determination that the species is Critically Endangered highlight the urgent need for effective conservation measures—including listing under the U.S. Endangered Species Act.

The smalltail shark is not listed under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).[133] CITES is an international agreement that seeks to ensure that international trade does not threaten wildlife and plants with extinction. Protection under CITES is particularly important for marine species in international trade. As NOAA explains,

> Many marine species that are traded internationally are highly migratory—meaning they swim long distances, often crossing national boundaries. Their conservation can only be achieved if nations work collaboratively. That's where CITES comes in. The agreement provides a legal framework to regulate the international trade of species, ensuring their sustainability and promoting cooperation among CITES members.[134]

Species can be listed under one of three CITES appendices: Appendix I, which protects species threatened with extinction by prohibiting commercial trade; Appendix II, which protects species that may become threatened with extinction by tightly regulating trade; and Appendix III, which

[128] International Union for Conservation of Nature (IUCN), The IUCN Red List of Threatened Species (2022), at https://www.iucnredlist.org/.
[129] Id.
[130] Vié, Jean-Christophe et al., The IUCN Red List: a key conservation tool, in Vié, Jean-Christophe et al. (eds)., Wildlife in a Changing World: An analysis of the 2008 IUCN Red List of Threatened Species 1 (2008).
[131] IUCN, supra note 128; International Union for Conservation of Nature (IUCN), Frequently Asked Questions: What are the IUCN Red List categories and criteria? (2022), at https://www.iucnredlist.org/about/faqs#What%20are%20the%20Red%20List%20Categories%20and%20Criteria.
[132] Rodrigues, Ana S.L. et al., The value of the IUCN Red List for conservation, 21 TRENDS in Ecology and Evolution 71 (2006).
[133] See Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Appendices I, II and III, valid from 22 June 2022, at https://cites.org/eng/app/appendices.php.
[134] Nat'l Oceanic & Atmospheric Admin., Convention on International Trade in Endangered Species of Wild Fauna and Flora (2022), at https://www.fisheries.noaa.gov/national/international-affairs/convention-international-trade-endangered-species-wild-fauna-and#:~:text=and%20Citizen%20Science-,Convention%20on%20International%20Trade%20in%20Endangered%20Species%20of%20Wild%20Fauna,their%20survival%20in%20the%20wild.

protects species for which member nations have requested some trade regulation.[135] Species not listed under CITES, like the smalltail shark, receive none of these protections. Should the smalltail shark be listed under the ESA, it would be afforded trade protections in the United States; these protections would occur automatically if the species is listed as endangered, or with the promulgation of a 4(d) rule if the species is listed as threatened.

In Brazil, the smalltail shark was listed as threatened with extinction by the Normative Instruction 05/2004.[136] In 2014, the smalltail shark was listed on the Brazilian Ordinance of the Ministry of Environment no. 445 (Dec. 17, 2014), a piece of legislation that aimed to restrict the harvest and trade of species listed on the Brazilian National Red List as Critically Endangered or Endangered.[137] This ordinance was litigated and suspended.[138] Even if it were put into effect, actualization of the legislative goals would be difficult given the difficulties of post-harvest species identification[139] and Brazil's refusal since 2011 to release official fishery statistics.[140]

Aside from retention prohibitions in certain parts of the smalltail shark's range, *see* Part III.4, *infra*, no effective species-specific protections or conservation measures for the smalltail shark are in effect across the species' range.[141] The IUCN states that conservation and recovery of the smalltail shark will require "a suit of measures … includ[ing] species protection, spatial management, bycatch mitigation, and harvest management, all of which will be dependent on effective enforcement."[142] ESA protection is a necessary measure for smalltail shark conservation and recovery.

PART II. THE SMALLTAIL SHARK IS A LISTABLE ENTITY UNDER THE ESA

The Endangered Species Act extends its protection to "species," a term broadly defined 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."[143] The smalltail shark, *Carcharhinus porosus*, is a "species" as defined by taxonomists and thus constitutes a listable entity under the U.S. Endangered Species Act. *See* Part I.1.A, *supra*.

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[135] See id.
[136] Santana et al., supra note 5, at 3.
[137] Santana et al., supra note 5, at 3 (stating that this reclassification resulted in part from "the recent increase in fishing effort with the use of longer gillnets spanning over 10 km, its occurrence in several different large scale fisheries for shrimp and teleosts, and its decreased national occurrence area, and lack of population increase"). See also Feitosa et al., supra note 58, at 2 (noting the development of a national plan of action for sharks and rays known as PAN-Tubarões in 2014). See also Feitosa et al., supra note 27, at 888.
[138] Pollum et al., supra note 7, at 6, citing Begossi, A. et al., Threatened fish and fishers along the Brazilian Atlantic Forest Coast, 46 Ambio 907 (2017), Spautz, D., Secretaria Nacional de Pesca pede para suspender lista de peixes ameaçados de extinção, NSC Total News (2019), available at https://www.nsctotal.com.br/colunistas/dagmara-spautz/secretaria-nacional-de-pesca-pede-para-suspender-lista-de-peixes; Baretto, R. et al., Rethinking use and trade of pelagic sharks from Brazil, 85 Marine Policy 114 (2017).
[139] Martins et al., supra note 123; Wosnick et al., supra note 123, at 9; Santana et al., supra note 5, at 14; Rodrigues-Filho et al., supra note 61, at 406; Liu et al., supra note 113, at 2. Dried fins are nearly impossible to identify without the aid of DNA identification techniques. Id.
[140] Cruz et al., supra note 110, at 3439, 3445; Santana et al., supra note 5, at 14. This continues to occur in Brazil even though such practices are illegal. Feitosa et al., supra note 58, at 2.
[141] Pollum et al., supra note 7, at 6.
[142] Id.
[143] 16 U.S.C. § 1532(16).

PART III. THE SMALLTAIL SHARK QUALIFIES AS THREATENED OR ENDANGERED UNDER THE ESA

The threats facing the smalltail shark, including overfishing, climate change, habitat degradation, inadequate regulatory mechanisms, and *K*-selected life history characteristics, place this species at risk of imminent extinction. Should NMFS find that this Petition "presents substantial scientific or commercial information indicating that the petitioned action may be warranted," 16 U.S.C. § 1533(b)(3)(A), the agency must conduct a status review to evaluate the smalltail shark's "endangered or threatened status … based on the Act's definitions of those terms and a review of the factors enumerated in section 4(a)."

Under the ESA, an "endangered species" is defined as "any species which is in danger of extinction throughout all or a significant portion of its range."[144] A "threatened species" is defined as "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."[145] The factors enumerated in section 4(a) include:

(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.[146]

The agency's review and determination must be based solely on the best scientific and commercial data available.[147] The following discussion describes threats to the smalltail shark falling under each of the 4(a) factors.

1. The Present or Threatened Destruction, Modification, or Curtailment of the Smalltail Shark's Habitat or Range

Habitat degradation and destruction harm elasmobranchs including the smalltail shark.[148] Such habitat loss and degradation may result from residential and commercial development, agriculture and aquaculture operations (including mangrove and estuary loss/degradation), pollution, natural system modification (including river engineering), human disturbance and intrusion, energy production and mining, invasive/problematic species, and transportation/service corridors.[149]

[144] Id. § 1532(6).
[145] Id. § 1532(20).
[146] Id. § 1533(a).
[147] Id. § 1533(b)(1)(A).
[148] Habitat degradation and loss are known to contribute to the plight of nearly one-fifth of threatened shark species. Dulvy et al., supra note 2, at 4778.
[149] Dulvy et al., supra note 2, at 4778; Sguotti, Camilla et al., Distribution of skates and sharks in the North Sea: 112 years of change, 22 Global Change Biology 2729 (2016); Dulvy et al., supra note 119.

Habitat degradation and destruction constitute primary threats to Brazil's marine biodiversity, including elasmobranch species.[150] For example, environmental degradation is one of the factors that led to the critical endangerment of largetooth sawfish (*Pristis perotteti*) in the country.[151] Approximately four percent of total mangrove area in the country—area that is critical for many shark species including the smalltail—has been lost to aquaculture conversions (primarily *Penaeid* srimp), industrial development including salt production, and urban development.[152] Mangroves also are vulnerable to climate change impacts including sea level rise, changes in estuarine dynamics, and more severe storms.[153]

Blanco-Parra and Niño-Torres (2022) note that habitat loss—particularly coastal ecosystem loss—is one of the primary threats to elasmobranchs in the Mexican Caribbean.[154] Many elasmobranchs in the Mexican Caribbean including the smalltail shark use those coastal ecosystems as their primary habitat.[155] The authors point to "uncontrolled and intense coastal development in the last 50 years" as having altered coastal ecosystems and affected coastal biodiversity.[156]

The U.S. Gulf of Mexico[157] represents one of the most industrialized and anthropogenically impacted marine ecosystems in the world. Industrial fisheries, shipping, and oil and gas exploration and development all have contributed to significant habitat degradation and ecosystem restructuring.[158] Agricultural and urban runoff, freshwater diversions, and urban

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[150] Amaral, Antônia Cecília Z. & Sílvio Jablonski, Conservation of Marine and Coastal Biodiversity in Brazil, 19 Conservation Biology 625, 625, 629 (2005).
[151] Palmeira, Carlos André Melo et al., Commercialization of a critically endangered species (largetooth sawfish, *Pristis perotteti*) in fish markets of northern Brazil: authenticity by DNA analysis, 34 Food Control 249, 249 (2013).
[152] Ferreira, Alexander Cesar & Luiz Drude Lacerda, Degradation and conservation of Brazilian mangroves, status and perspectives, 125 Ocean & Coastal Mgmt. 38, 38, 39, 40 (2016).
[153] Id. at 38; see generally Gilman, Eric L. et al., Threats to mangroves from climate change and adaptation options, 89 Aquatic Biology 237 (2008).
[154] Blanco-Parra, María del Pilar & Carlos Alberto Niño-Torres, Elasmobranchs of the Mexican Caribbean: biodiversity and conservation status, 105 Environmental Biology Fishes 151, 161-62 (2022).
[155] Id. at 162.
[156] Id.
[157] Yáñiz-Arabcibia, Alejandro & John W. Day, The Gulf of Mexico: towards an integration of coastal management with large marine ecosystem management,47 Ocean & Coastal Management 537 (2004) (describing the Gulf of Mexico large marine ecosystem).
[158] See, e.g., Baum & Myers, supra note 45 (impacts of fisheries on pelagic sharks in the Gulf of Mexico); Ko, Jae-Young & John W. Day, A review of ecological impacts of oil and gas development on coastal ecosystems in the Mississippi Delta, 47 Ocean & Coastal Mgmt. 597 (2004) (impacts of oil and gas on Gulf ecosystems); Rabalais, N.N., Troubled waters of the Gulf of Mexico, 24 Oceanography 200 (2011) (multiple threats facing Gulf waters); Casper, Brandon M. et al., Are sharks even bothered by a noisy environment?, in Popper, A.N. & A. Hawkins (eds.), The effects of noise on aquatic life (2012) (discussing possible impacts of anthropogenic noise on sharks including masking, temporary threshold shifts, stress/hormone responses, barotrauma, and other physiological injury); Hildebrand, John A. , Anthropogenic and natural sources of ambient noise in the ocean, 395 Marine Ecology Progress Series 5 (2009) (high level of anthropogenic noise from oil and gas exploration in the Gulf of Mexico); Estabrook Bobbi J. et al., Widespread spatial and temporal extent of anthropogenic noise across the northeastern Gulf of Mexico shelf ecosystem, 30 Endangered Species Research 267 (2016) (anthropogenic noise in northeast Gulf of Mexico); Gedamke, Jason et al., Ch. 40: Predicting anthropogenic noise contributions to US waters, in Popper, Arthur N. & Anthony Hawkins (eds.), The Effects of Noise on Aquatic Life II (2016) (chronic noise from vessels and oil and gas activities in the Gulf of Mexico); Chapuis, Lucille et al., The effect of underwater sounds on shark behaviour, 9 Nature Sci. Reports 6924 (2019) (concerning effects of anthropogenic noise on reef shark behavior); Bureau of Ocean Energy Management, 2023-2028 National Outer Continental Shelf Oil and Gas Leasing

development have degraded coastal waters and important estuarine habitats.[159] Dead zones represent an ongoing threat to Gulf ecosystems and communities.[160] Harmful algal blooms are increasing alongside climate change.[161] And the Deepwater Horizon disaster highlights the eternal threat of a catastrophic oil spill in this heavily industrialized area.[162]

One of the more well-studied habitat-related threats to sharks is contaminant pollution.[163] Long-lived, high-level predators like sharks bioaccumulate a variety of contaminants including heavy metals like mercury, cadmium, and lead. Scientists have become increasingly concerned with the potential for sublethal impacts of bioaccumulated toxic pollutants on shark health and fitness.[164] Such concerns are greater when sharks inhabit coastal areas near large urban centers, which increases their risk of contaminant exposure.[165] Smalltail sharks fit this risk profile in certain portions of their range. For example, smalltail sharks are known to inhabit estuaries off Corpus Christi, Texas, which places them at high risk of encountering contaminants.[166]

Heavy metals represent one contaminant category of particular concern.[167] These metals can lead to toxicological effects on the nervous system, kidneys, and bone.[168] Lead accumulation in the liver, muscle, gills, and rectal gland has been shown to affect spiny dogfish (*Squalus acanthias*) osmoregulation, energy metabolism, and respiratory capacity.[169] Silver and copper accumulation in a variety of tissues (liver, kidney, skin, gills, intestine, rectal gland) in spiny dogfish and spotted dogfish (*Scyliorhinus canicular*) result in hyperventilation, respiratory disturbance,

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Proposed Program 7 (2022) (noting that in 2021, the Gulf of Mexico accounted for 99% of all outer continental shelf oil and gas production, and that more than 25% of 1,963 active leases were in production as of June 2022).

159 Day, J.W., W.J. Mitsch & A. Yanez-Arancibia, Ch. 27: Using ecotechnology to address water and habitat loss quality in estuarine systems, Gulf of Mexico: a synthesis, in Yáñez-Arancibia, A. et al. (eds.), Ecological Dimensions for Sustainable Socio Economic Development (2013) (describing coastal habitat loss in the Gulf of Mexico).

160 Rabalais, Nancy N. & R. Eugene Turner, Gulf of Mexico hypoxia: past, present, and future, 28 Limnology & Oceanography Bull. 117 (2019). See also Doney, Scott C. et al., Climate change impacts on marine ecosystems, 4 Annual Rev. Marine Sci. 11 (2012).

161 See Doney et al., supra note 160; Paerl, Hans W. & Jef Huisman, Blooms like it hot, 320 Sci. 57 (2008); Hallegraeff, Gustaaf M., Ocean climate change, phytoplankton community responses, and harmful algal blooms: a formidable predictive challenge, 46 J. Phycology 220 (2010); Moss, Brian et al., Allied attack: climate change and eutrophication, 1 Inland Waters 101 (2011).

162 See, e.g., Paul, John H. et al., Toxicity and mutagenicity of Gulf of Mexico waters during and after the Deepwater Horizon oil spill, 47 Envt'l Sci. & Tech. 9651 (2013); Nixon, Zachary et al., Shoreline oiling from the Deepwater Horizon oil spill, 107 Marine Pollution Bull. 170 (2016); Baker, Mary C., Marla A. Steinhoff & Gail F. Fricano, Integrated effects of the Deepwater Horizon oil spill on nearshore ecosystems, 576 Marine Ecology Progress Series 219 (2017); Rouhani, Shahrokh et al., Nearshore exposure to Deepwater Horizon oil, 576 Marine Ecology Progress Series 111 (2017); Ainsworth, Cameron H. et al., Impacts of the Deepwater Horizon oil spill using an end-to-end ecosystem model, 13 PLoS ONE e0190840 (2018).

163 See, e.g., Amaral & Jablonski, supra note 150, at 629 (noting the challenges in Brazil created by "pollution, mainly from pesticides, chemical products, and industrial effluents" as well as "largely untreated organic matter discharged into the oceans").

164 Wosnick et al., supra note 123, at 9.

165 Swift & Portnoy, supra note 83, at 789.

166 Id.

167 Mohammed & Mohammed, supra note 119, at 214.

168 Id.

169 Wosnick et al., supra note 123, at 1, citing Eyckmans, M. et al., Physiological effects of waterborne lead exposure in spiny dogfish (Squalus acanthias), 126 Aquatic Toxicology 373 (2013).

altered anaerobic metabolism, lactate accumulation, blood alkalosis, hemolysis, and erythrocyte swelling.[170] Mercury exposure may negatively affect the blacktip shark (*Carcharhinus limbatus*) liver.[171]

Mohammed & Mohammed (2017) found elevated levels of lead, cadmium, mercury, and arsenic in smalltail sharks off Trinidad and Tobago.[172] Wosnick *et al.* (2021) examined metal concentrations in a sample of coastal sharks (including smalltail shark) obtained from artisanal fisheries in São Luís, Maranhão, Brazil.[173] They found high concentrations of various metals (cobalt, manganese, nickel, copper, iron, and mercury) in shark livers and rectal glands with implications for osmoregulatory capacity and systemic health.[174] They found evidence that cobalt was associated with liver damage, and increased iron and mercury concentrations affected liver and kidney functioning potentially associated with metabolic dysfunction.[175] Higher iron and mercury concentrations in the gills were associated with urea and lactate dysregulation, potentially indicating gill dysfunction.[176] Higher cobalt, manganese, and mercury concentrations in the rectal gland alongside elevated levels of circulating phosphorus suggested effects on enzyme functioning, osmoregulation, and/or metal toxicity-induced cell membrane denaturation.[177] Overall lower metal concentrations in the gills led the authors to believe that bioaccumulation occurs primarily through diet rather than direct environmental exposure.[178]

Wosnick *et al.* (2021) also found that female sharks exhibited higher concentrations of cobalt, nickel, and copper and associated lower condition factors than male sharks.[179] If this results in reduced fecundity and reproductive success, this could have grave demographic and population-level consequences for affected shark species.[180] Even if sublethal contaminant effects are not linked to reproductive success *per se*, they do impair shark health, compromise fitness, and thus may impact population recruitment.[181] Smalltail shark contaminant exposures thus represent an additional stressor that adds to the species' extinction risk.

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[170] Wosnick et al., supra note 123, at 1-2, citing De Boeck, G. et al., Sensitivity of the spiny dogfish (*Squalus acanthias*) to waterborne silver exposure, 54 Aquatic Toxicology 261 (2001), De Boeck, G. et al., Copper toxicity in the spiny dogfish (*Squalus acanthias*): urea loss contributes to the osmoregulatory disturbance, 84 Aquatic Toxicology 133 (2007), De Boeck, G. et al., Metal accumulation and metallothionein induction in the spotted dogfish *Scyliorhinus canicular*, 155 Comp. Biochem. Physiol. A Mol. Integr. Physiol. 503 (2010).
[171] Wosnick et al., supra note 123, at 2, citing Norris, S.B. et al., Mercury in neonatal and juvenile blacktip sharks (*Carcharhinus limbatus*). Part II: effects assessment, 15 Ecotoxicology 1 (2021).
[172] Mohammed & Mohammed (2017), supra note 119, at 215.
[173] Wosnick et al., supra note 123, at 2, 5
[174] Id. at 8.
[175] Id.
[176] Id.
[177] Id. 8.
[178] Wosnick et al., supra note 123, at 7.
[179] Id. at 8.
[180] Id.
[181] Id. at 9.

2. Overutilization of Smalltail Sharks for Commercial, Recreational, Scientific, or Educational Purposes

Overutilization for fishing is the primary cause of the smalltail shark's rapid and precipitous decline. The requiem sharks (family Carcharhinidae) are the most species-rich shark family and account for the majority of the global shark trade; much of this catch occurs in unregulated and unreported fisheries.[182] The multi-billion-dollar shark fin trade largely feeds Asian markets, while meat is an important driver of market demand in South America.[183] Squalene derived from shark liver oil is used in the cosmetic industry, and shark products are found in pet food.[184]

Between 1970 and 2015, the probability of catching smalltail sharks declined throughout the species' range due to overharvesting.[185] Both commercial demersal trawl fisheries, including shrimp trawl fisheries, and artisanal gillnet fisheries capture smalltail sharks.[186] Longline and gillnet fisheries targeting other coastal sharks generally retain incidentally caught smalltail sharks.[187] Over the past three generation lengths (27 years), the IUCN estimates that fishery overexploitation has led to a global population reduction for smalltail sharks of > 80%.[188] In the species' core distribution, demographic modeling reveals a population reduction of > 90% over three generation lengths as fishing mortality greatly exceeded population growth.[189]

The species has been particularly hard-hit by fisheries in the southern Gulf of Mexico and off of Brazil.[190] Brazil is estimated to harvest 12,000 tons of sharks annually, making it the sixth highest nation in terms of shark sales globally.[191] Brazilian harvest primarily occurs for the fin trade and secondarily for meat.[192] Brazil is a major supplier in the international fin trade and smalltail shark is one of the top three species in shipments seized from Brazil.[193] DNA barcoding

[182] Feitosa et al., supra note 58, at 5; Cardeñosa et al., supra note 122, at 204.
[183] Liu et al., supra note 113, at 1, citing Teo, L.G.P., Man eating shark: unravelling the debate on (un)ethical consumption of shark's fin in Singapore (2015); Wainwright, B.J. et al., DNA barcoding of traded shark fins, meat and mobulid gill plates in Singapore uncovers numerous threatened species, 19 Conservation Genetics 1393 (2018).
[184] Cardeñosa, supra note 113; Liu et al., supra note 113, at 1.
[185] Pollum et al., supra note 7, at 1.
[186] Id. at 1, 5.
[187] Id. at 5, citing Pérez-Jiménez & Méndez-Loeza, supra note 49. See also Lessa & Santana, supra note 27, at 705 (noting that smalltail "is generally a by-catch species").
[188] Pollum et al., supra note 7, at 2.
[189] Id. at 2.
[190] Id. at 1.
[191] Marceniuk et al., supra note 61, at 122.
[192] Rodrigues-Filho et al., supra note 61, at 405; da Silva Ferette, B.L. et al., DNA-based species identification of shark finning seizures in Southwest Atlantic: implications for wildlife trade surveillance and law enforcement, 28 Biodiversity & Conservation 4007, 4009 (2019).
[193] da Silva Ferrette et al., supra note 192, at 4009, 4014; Feitosa et al., supra note 58, at 3-6.

has identified the species in Brazilian fishery catch.[194] Smalltail shark has been identified in traded shark fins in Singapore,[195] mainland China,[196] and Hong Kong.[197]

Locally, smalltail shark meat in Brazil is used for subsistence or sold as "cação."[198] The term "cação" is a generic term that does not have any real meaning in Portuguese.[199] It is an obfuscatory term meant to gain consumer acceptance while undermining environmental regulations and facilitating threatened species' depletion.[200]

In northern Brazil, high-pressure, highly commercialized artisanal fishing led to the overfishing of 44% of target stocks in the early 2000s.[201] Artisanal fisheries, which operate from small to medium-sized vessels with reduced storage capacity, often practice predatory fishing practices.[202] In response to this overfishing and the consequent biomass depletion, both gillnetting effort and length of gillnets used have increased.[203] Despite this increase in effort, smalltail sharks now rarely are caught in Maranhão.[204] While the species is still caught in shrimp trawl and gillnet fisheries in Amapá and Pará, catch rates have declined precipitously in the 2000s: from 2.87 kg/hr to 0.43 kg/hr – representing a population reduction of 85% over three generation lengths.[205]

In northeastern and eastern Brazil, intense gillnet artisanal fishing has led to the overexploitation of Acoupa weakfish, Brazilian Spanish mackerel, and gilbacker sea catfish (*Cynoscion acoupa*) and the depletion of a variety of shark species.[206] In southern Brazil, fishing pressure has been high both in the demersal trawl fishery and artisanal fisheries; nearly 60% of artisanal target

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[194] da Silva Ferrette et al., supra note 192, at 4014; Rodrigues-Filho et al., supra note 61, at 409; Cruz et al., supra note 110, at 3440; Martins et al., supra note 123, at 4.
[195] Liu et al., supra note 113, at 3.
[196] Cardeñosa et al., supra note 124, at 5.
[197] Cardeñosa et al., supra note 122, at 205. See also Fields, Andrew T. et al., Species composition of the international shark fin trade assessed through a retail-market survey in Hong Kong, 32 Conservation Biology 376, 383 (2018).
[198] Pollum et al., supra note 7, at 5, citing Dent, F. & S. Clarke, State of the global market for shark products, FAO Fisheries & Aquaculture Tech. Paper No. 590 (2015); Martins et al., supra note 123, at 4, 6-7; Wosnick et al., supra note 113, at 160. A recent forensic analysis found 17 different shark species being sold as "cação;" when other studies are taken into account, that number rises to 43. Cruz et al., supra note 110, at 3441.
[199] Cruz et al., supra note 110, at 3438.
[200] Id. at 3438, 3444. See also Marceniuk et al., supra note 61, at 122 (noting that elasmobranch species are often mislabeled when sold).
[201] Pollum et al., supra note 7, at 5-6, citing Vasconcellos, M., A.C. Diegues & D.C. Kalikoski, Coastal fisheries of Brazil, in Salas, R. et al. (eds.), Coastal fisheries of Latin America and the Caribbean (2011), Martins et al., supra note 119; Rodrigues-Filho et al., supra note 61, at 405 (stating that as of 2004 data, annual shark catch over the past two decades was ~30,000 tons, with subsequent catch declines); Feitosa et al., supra note 58, at 2.
[202] Feitosa et al., supra note 58, at 2.
[203] Pollum et al., supra note 7, at 6, citing Mourão et al. 2014 (paper not included in Pollum et al. Literature Cited), Lessa, R. 2020 (unpublished data).
[204] Pollum et al., supra note 7, at 1.
[205] Id.
[206] Id. at 6, citing Guebert-Bartholo, F.M. et al., Fishery and the use of space in a tropical semi-arid estuarine region of Northeast Brazil: subsistence and overexploitation, 64 J. Coastal Research 398 (2011), Reis-Filho, J.A. et al., Traditional fisher perceptions on the regional disappearance of the largetooth sawfish *Pristis pristis* from the central coast of Brazil, 29 Endangered Species Research 189 (2016).

stocks are overexploited and half of those have collapsed.[207] The smalltail shark has not been recorded in more than 15 years in eastern and southern Brazil (between the states of Ceará and Paraná).[208]

Santana et al. (2020) analyzed catch and biological information for nearly 1000 smalltail sharks caught in gillnet fisheries off the coast of Brazil to determine the effects of fishing on this species.[209] They found that fishing occurred at a level 92.3% above the fishing mortality level that would lead to population equilibrium.[210] In the absence of fishing, the smalltail shark population was expected to be close to equilibrium, with an annual rate increase of 0.3%.[211] This low growth rate even in the absence of anthropogenic mortality demonstrates the inherent vulnerability of this population to overexploitation.[212] *See also* discussion Part III.5.A, *infra*. Juvenile smalltail shark survival was found to be particularly important for overall population persistence—and juveniles represent a significant proportion of fisheries catch.[213] Santana et al. (2020) conclude:

> Based on the demographic analysis, *C. porosus* decline in [Brazil's north coast (BNC)] was caused by intense overfishing. All the information obtained by this study points toward a sharp decline in *C. porosus* population in its global center of abundance[214] and the most important region for this species conservation in the world. In the BNC, gillnet fisheries in the 1980s caught essentially juvenile *C. porosus*, especially those with [sic] 2 years old, who accounted for 37.8% in these fisheries. Catching individuals 4 years before they reach sexual maturity causes a significant decline in the reproductive stock, also reducing biological recruitment levels in the population, which would help to maintain its sustainability. … In the smalltail shark's case, we estimated the fishing mortality rate for this species to be almost 100% higher than the population could withstand.[215]

With an exploitation rate greater than that required for sustainability, "fisheries overexploitation magnified the population decline already caused by the fishing recruitment of juveniles."[216] As their analysis only considered gillnet fishery catch, the sharks' plight would be "worsened if we consider[ed] the existence of shrimp and teleost trawl fisheries."[217]

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[207] Pollum et al., supra note 7, at 6, citing Vasconcellos, supra note 201.
[208] Pollum et al., supra note 7, at 1-2; Santana et al., supra note 5, at 14.
[209] See generally Santana et al., supra note 5.
[210] Id. at 1, 7.
[211] Id.
[212] Id.
[213] Id.
[214] Santana et al. note that much of Brazil's north coast "has been considered as a global conservation hotspot for elasmobranchs due to its high degree of irreplaceability as a crucial habitat for these animals." Santana et al., supra note 5, at 15.
[215] Id. at 9.
[216] Id.
[217] Id.

In Venezuela, artisanal and commercial fishers' traditional harvest has included many shark and ray species.[218] Artisanal fisheries take the bulk (94%) of this catch, though exact numbers are unknown due to the lack of quantitative assessments.[219] A recent analysis of elasmobranchs taken in Sucre State, one of the county's most important fishing areas, reveals smalltail shark as a relatively important (3.1%) component of that catch.[220] Smalltail shark was one of the most important species taken in commercial fisheries further east, between Trinidad and Tobago and Guyana.[221]

Smalltail sharks are threatened by fishing in the Gulf of Mexico. Bravo-Zavala et al. (2022) assessed the vulnerability of elasmobranch species including the smalltail shark to fisheries in the southern Gulf of Mexico, specifically the states of Tabasco, Campeche, and Yucatán, Mexico.[222] Smaller-sized sharks are the most frequent elasmobranchs caught in this region, largely as a result of their coastal-demersal habitat preferences.[223] The smalltail shark had the highest vulnerability and cumulative vulnerability among small sharks, and a relatively higher cumulative vulnerability and cumulative susceptibility pre-1990[224]—perhaps indicative of the species' declining abundance in the region.[225] Fisheries (*e.g.*, shrimp) represent one of the primary threats to elasmobranchs including the smalltail shark in the Mexican Caribbean.[226]

In the United States, smalltail sharks are incidentally caught in the Gulf of Mexico. Elasmobranchs are captured in the Gulf of Mexico demersal shrimp trawl fishery and an intensive bottom longline fishery.[227] Shrimp trawls are known for their very high bycatch rates—historically >10 kg of bycatch per 1 kg of landed shrimp—and the Gulf of Mexico shrimp trawl fishery has led to "[c]onsiderable undirected fishing mortality" of elasmobranchs in the region.[228] Smalltail sharks have been recorded as bycatch in the Gulf shrimp trawl fishery, which concentrates its effort nearshore at depths < 20 m.[229] Shepherd & Myers (2005) attribute the decline in elasmobranch abundance in the Gulf of Mexico to the species' mortality as bycatch in the shrimp trawl fishery.[230] The introduction of turtle excluder devices and fish bycatch reduction devices does not appear to have affected the abundance trends of costal elasmobranchs in the

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[218] Marquez, Raquel, Rafael Tavares & Luis Alejandro Ariza, Elasmobranch species in the artisanal fishery of Sucre State, Venezuela, 45 Ciencias Marinas 181, 181 (2019).
[219] Id. at 182.
[220] Id. at 182, 184.
[221] Id. at 185, citing Shing, C.C.A., Shark fisheries of Trinidad and Tobago: a national plan of action, 57 Gulf Caribbean Fish. Inst. 205 (2006); Kolmann et al., supra note 57.
[222] Bravo-Zavala, Fátima Guadalupe et al., Vulnerability of 14 elasmobranchs to various fisheries in the southern Gulf of Mexico, 73 Marine & Freshwater Research 1064 (2022).
[223] Id. at 1074.
[224] Id.
[225] See id. (noting that C. porosus currently is rare in catches).
[226] Blanco-Parra & Niño-Torres, supra note 154, at 161, 162, citing García-Zúñiga, J.E. et al., Captura incidental de elasmobranquios en la pesca de arrastre de camarón en Quintana Roo, México, in Memorias Primer Congreso Latinoamericano de Tiburones, Rayas y Quimeras, VIII Simposio Nacional de Tiburones y Rayas Playa del Carmen, Quintana Roo, Mexico (2019).
[227] Shepherd & Myers, supra note 64; Scott-Denton, Elizabeth et al., Descriptions of the U.S. Gulf of Mexico reef fish bottom longline and vertical line fisheries based on observer data, 73 Marine Fisheries Rev. 1, 7 (Table 4) (2011) (predominant target fisheries include groupers (Epinephalus spp.) and snappers (Lutjanus spp.)).
[228] Shepherd & Myers, supra note 64, at 1095-1096.
[229] Id. at 1097, Table 1, 1098.
[230] Id. at 1100.

Gulf.[231] Shepherd and Myers (2005) conclude that "[a] number of species … appear to be headed towards eradiation from the northern Gulf of Mexico coastal ecosystem," including small coastal sharks like the smalltail.[232]

Smalltail shark fins are sold in markets across Asia, including Hong Kong, mainland China, and Singapore.[233] In addition to the large, high-valued shark fins used to make shark fin soup, there is a burgeoning market for less expensive, small fins—like those of the smalltail shark.[234] Recent research reveals that the smalltail shark is one of the primary species apprehended in fin shipments in Brazil.[235] Indeed, since 2004, over 83 tons of shark fins have been seized in Brazil; the country is ranked as the world's 11th largest exporter of shark fins and is a major black market hotspot.[236] While small shark fins like those obtained from smalltail sharks might be less lucrative and less common in trade, the trade itself is so large (*i.e.*, ~6000 tons of fins imported into Hong Kong annually) that fishing pressure for the small fin trade could put the smalltail shark in jeopardy.[237] As Cardeñosa *et al.* (2022) explain:

> For species with smaller and less valuable fins that are also threatened with exctincion (e.g., small tail shark [*C. porosus*], … the question then becomes: to what extent is the international fin trade the ultimate driver of overfishing? Fins of these coastal species can be small (i.e., < 10 cm), are commonly found in the Hong Kong markets, and arrive to Hong Kong in containers with millions of fins. Therefore, even though individual fins from many of these species do not fetch particularly high commercial value, in large quantities, low-value fins still provide a lucrative enterprise, potentially creative incentive to retain bycatch or even target these species. Whether a high-value or low-value species, our study indicates that international trade is potentially an ultimate threat.[238]

In sum, fishing overexploitation for the fin trade, local consumption, and other shark products poses an existential threat to the smalltail shark. This is the primary threat to the species throughout much of its range and, if not ameliorated, appears likely to drive the species to extinction.

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[231] Id. at 1101-02.
[232] Id. at 1101.
[233] Cardeñosa et al., supra note 122, at 203, 205; Cardeñosa, Diego et al., Two thirds of species in a global shark fin trade hub are threatened with extinction: conservation potential of international trade regulations for coastal sharks, Conservation Letters e12910, at 4 (2022); Liu et al., supra note 113, at 3.
[234] Cardeñosa et al., supra note 122, at 203, 205.
[235] da Silva Ferrette et al., supra note 192.
[236] Id. at 4018, citing Baretto et al., supra note 138. See also da Silva Ferrette et al., supra note 192, at 4018 (noting that between 2004-2013, officials carried out at least 15 raids to prevent illegal fin trading in Brazil).
[237] Cardeñosa et al., supra note 233, at 6-7.
[238] Id. at 8.

3. Disease or Predation in Smalltail Sharks

While smalltail sharks are predated upon by larger sharks,[239] neither predation nor disease is known to be a major factor in the smalltail shark's decline.

4. Inadequacy of Existing Regulatory Mechanisms for Smalltail Shark Protection

Existing regulatory mechanisms fail to protect the smalltail shark from extinction. Both fisheries regulation and climate change regulation are particularly insufficient, as described in more detail below, and efforts to protect estuaries mangrove forests in Brazil have been ineffective due to lack of enforcement.[240]

A. Fisheries Regulations

Regulation of shark fisheries in many regions is insufficient or nonexistent, and catch volume estimates and landing data often are superficial, aggregated (*i.e*., not species-specific), and incomplete. Stevens et al. (2000) note that as of the turn of the century, "[s]ome 50% of the estimated global catch of chondrichthyans is taken as by-catch, does not appear in official fishery statistics, and is almost totally unmanaged."[241] Furthermore, it appears that many nations' finning regulations are being sidestepped through landing of entire sharks, whose meat increasingly is consumed.[242]

Lack of effective management plagues global shark harvest and trade.[243] While regulatory frameworks continue to evolve as the shark extinction crisis becomes clearer, "these actions cover a small fraction of chondrichthyans, are applied unevenly across species' ranges, frequently fall short of scientific advice, and are often inadequate."[244] There exists no global mechanism to ensure financing, implementation, and enforcement of chondrichthyan fishery management measures, and most countries lack the expertise, resources, and political will to conserve these species.[245] Clear management gaps exist "for coastal species, especially noncosmopolitan species that are less common in trade than the dominant cosmopolitan species but still traded at concerning levels."[246]

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[239] See, e.g., Lessa & Almeida, supra note 102; Florida Museum, supra note 12.
[240] Ferreira & Lacerda, supra note 152, at 38, 39, 40.
[241] Stevens et al., supra note 114, at 476. See also Wosnick et al., supra note 113, at 160 (noting that "most of the countries that overexploit local populations have little or no management plans in place for their elasmobranch resources and almost nothing is known about the status of fishery stocks").
[242] Wosnick et al., supra note 113, at 160, citing Bornatowski, H., R.R. Braga & R.P. Barreto, Ch. 10: Elasmobranchs consumption in Brazil: impacts and consequences, in Rossi-Santos, M.R. & C.W. Finkl (eds.), Advances in Marine Vertebrate Research in Latin America (2018).
[243] Cardeñosa et al., supra note 122, at 207 ("Our study highlights the need for better and stronger fisheries management in many coastal regions where sustainability is still a difficult goal to achieve"); Cardeñosa et al., supra note 233; Pérez-Jiménez, supra note 51.
[244] Dulvy et al., supra note 2, at 4774. See also id. at 4781-82.
[245] Dulvy et al., supra note 119, at 12.
[246] Cardeñosa et al., supra note 233, at 9.

The ongoing failures of shark management can be attributed to lack of science-based decision making, poor enforcement, influential lobbying from fishing interests, and weak to no regulation in either the sharks' home range countries or demand centers.[247] Effective shark management requires knowledge of the stock (research, assessment, ongoing monitoring), the political will to enact science-based and effective regulations, and the enforcement capacity to ensure the laws are followed.[248] For species like the smalltail shark that largely occupy areas outside of high-capacity nations (*i.e.*, nations that have sufficient resources devoted to sustainable fisheries management), the risks of extirpation and extinction are elevated.[249] As explained by Cardeñosa *et al.* (2022):

> At greatest risk of global extinction are the threatened and traded species that do not occur or have marginal populations in the high-capacity nations. … Several species in the dried fin trade fit this risk profile (e.g., smalltail shark [*C. porosus*]) …. Without effective management, this group of species is likely to form the next series of chondrichthyan extinctions.[250]

Smalltail sharks are "subjected to intense and largely unmanaged fishing pressure across [their] range."[251] The Western Central Atlantic lacks fishery management across much of the region.[252] For example, along the Caribbean coast of Central America and coastal Atlantic South America, artisanal fishing is largely unregulated.[253] Stocks have collapsed in the Caribbean Colombia shallow-water shrimp trawl fishery.[254] Intensive commercial and artisanal fisheries in Venezuela lack management and are exhibiting catch declines consistent with sequential overfishing.[255] On the Brazil-Guianas shelf, a variety of multi-gear, multi-species, multinational groundfish fisheries were fully over-exploited by the year 2000.[256] In Venezuela, there exists one fishery regulation meant to prohibit the fishing and retention of a subset of species (not including *C. porosus*); fishery regulations generally are not adhered to throughout Venezuela's insular and coastal regions for a variety of reasons including the collapse of institutions charged with regulating and managing fisheries in the country.[257]

National regulatory schemes specific to the smalltail shark are described in the following paragraphs.

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[247] da Silva Ferrette et al., supra note 192, at 4018, citing de Mitcheson, Yvonne Sadovy et al., Out of control means off the menu: the case for ceasing consumption of luxury products from highly vulnerable species when international trade cannot be adequately controlled; shark fin as a case study, 98 Marine Policy 115 (2018).
[248] Cardeñosa et al., supra note 233, at 2.
[249] Id. at 8.
[250] Id.
[251] Pollum et al., supra note 7, at 6.
[252] Id.
[253] Id. at 4, 5.
[254] Id. at 5, citing Mefía-Falla, P. & A. Navia 2018 (unpublished data).
[255] Pollum et al., supra note 7, at 5, citing Mendoza, J.J., Rise and fall of Venezuelan industrial and artisanal marine fisheries: 1950-2010, in Univ. British Columbia Fisheries Centre Working Paper Series (2015).
[256] Pollum et al., supra note 7, at 5, citing Booth, A. et al., Regional Assessment of the Brazil-Guianas Groundfish Fisheries, Regional Reviews and Nat'l Mgmt. Reports, Fourth Workshop on the Assessment and Management of Shrimp and Groundfish Fisheries on the Brazil-Guianas Shelf (2001).
[257] Marquez, Tavares & Ariza, supra note 218, at 187.

United States: The Consolidated Atlantic Highly Migratory Species Fishery Management Plan lists the smalltail shark as a prohibited species[258] and retention of smalltail shark likewise is prohibited in state waters.[259] Despite these prohibitions, sharks including the smalltail continue to be caught in Gulf of Mexico fisheries.[260] The use of turtle excluder devices and fish bycatch reduction devices in the Gulf of Mexico shrimp trawl fishery has not had a positive impact on small coastal elasmobranch abundance trends in the Gulf of Mexico.[261] "This being the case, if there is to be hope for the future recovery of small coastal elasmobranchs in this region, other management actions … will be needed."[262]

Mexico: Mexico "lack[s] effective regional sustainable [shark fishery] management."[263] Generic gear restrictions, license restrictions, and seasonal closures are in effect for all shark species in Mexico.[264] These measures are not species-specific and do not account for life history variation between species.[265] The country's official catch statistics classify sharks into only two categories: small shark species (cazón) and large shark species (tiburón).[266] Further, "artisanal, unregulated, and under-reported fisheries … prevail in Mexico and both Central and South America," likely resulting in overfishing of smalltail sharks in all those regions.[267] Mexico's recently released management plan for Gulf of Mexico fisheries is vague and does not provide sufficient protective measures for the smalltail shark.[268]

Blanco-Parra and Niño-Torres (2022) cite a lack of regulation and enforcement as one of the primary threats to elasmobranchs in the Mexican Caribbean.[269] They cite two current regulations on elasmobranch fishing in that region. The first is the Mexican Norm for Shark and Ray Fisheries (NOM-029-PESC 2006), which regulates fishery gear, designates closed areas, and sets season timing.[270] It also prohibits the capture of a small number of species.[271] The other is Rule

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258 Nat'l Marine Fisheries Serv. (NMFS), Final Consolidated Atlantic Highly Migratory Species Fishery Management Plan 3-109, Table 3.16 (2006).
259 See Ala. Admin. Code r. 220-3-.37 (2022); Marine Resources Div., Ala. Dep't Conservation & Natural Resources, Alabama Recreational Fishing; Fl. Fish Rules, Shark, Smalltail; La. Wildlife & Fisheries, 2022 Louisiana commercial and for-hire fisheries rules and regulations (2022); La. Wildlife & Fisheries, 2022 Louisiana recreational fishing regulations (2022); Miss. Dep't Marine Resources, Title 22, Part 3, Regulations to provide size limits and bag limits on certain fish species, prevent sale of seafood by recreational fishermen, and provide regulations for the use of nets, traps, and pots for the taking of finfish; Tex. Parks & Wildlife, Texas commercial fishing regulations summary 2022-2023; Tex. Parks & Wildlife Dep't, Prohibited shark species.
260 See generally Shepherd & Myers, supra note 64; Scott-Denton et al., supra note 227, at 7 (Table 4).
261 Shepherd & Myers, supra note 64, at 1101-02.
262 Id. at 1102.
263 Pérez-Jiménez et al., supra note 51, at 1183.
264 Pollum et al., supra note 7, at 6.
265 Id. at 6, citing Pérez-Jiménez & Méndez-Loeza (2015), supra note 49.
266 Pérez-Jiménez et al., supra note 51, at 1182-83.
267 Feitosa et al., supra note 27, at 888, citing Salas, S. et al., Coastal fisheries of Latin America and the Caribbean (2011).
268 Secretaria de Gobernación, Acuerdo por el que se da a conocer el Plan de Manejo Pesquero de Tiburones y Rayas del Golfo de México y Mar Caribe (2022), at https://www.dof.gob.mx/nota_detalle.php?codigo=5654592&fecha=09/06/2022#gsc.tab=0.
269 Blanco-Parra & Niño-Torres, supra note 154, at 161.
270 Id. at 162; Pérez-Jiménez et al., supra note 51, at 1183.
271 Pérez-Jiménez et al., supra note 51, at 1183.

94, a regulation prohibiting shark fishing in the Mexican Caribbean Biosphere Reserve.[272] However, the small-scale nature of many of the multispecies coastal fisheries and a lack of enforcement impedes the effective implementation of these regulations.[273] Furthermore, there is no difference in elasmobranch fisheries management between the Mexican Caribbean and the Gulf of Mexico despite differing oceanographic conditions, biodiversity, and fishery fleet behavior; Blanco-Parra and Niño-Torres (2022) recommend separating the two regions to create more regionally specific and more effective management regimes.[274]

Columbia: A prohibition on targeted industrial fishing of sharks and rays is in effect and bycatch is limited to 35%.[275] Compliance and surveillance, however, appear inadequate.[276]

Brazil: The legal framework protecting smalltail sharks and other elasmobranchs in Brazil is insufficient and obsolete.[277] According to Santana et al. (2020), Brazil "has an intense artisanal and semi-industrial fishery with elevated elasmobranch bycatch levels, and little to no regulation for almost ten years now."[278] No law currently in effect regulates elasmobranch fishing in Brazil and the country has not had a nationally standardized fisheries data collection system since 2007 nor has it released official fishery statistics since 2011.[279] This is despite the fact that Brazil is estimated to have the world's 11th highest elasmobranch capture rate.[280] As summarized in one analysis, "overfishing, undifferentiated commercialized species, and the lack of proper management and information have placed Brazilian sharks at a significant risk."[281] In the case of *C. porosus*, "the overall inaction of the environmental agencies and the Brazilian government were key to the current state of [the species'] populations in Brazil."[282]

As a result of intense, unmanaged fishing pressure from both artisanal and commercial fleets in northern Brazil, a third of Brazil's shark species are listed in the Brazil Red Book of Threatened Species as under extinction threat.[283] Several elasmobranch species have disappeared from the region including the daggernose shark (*Isogomphodon oxyrhynchus*), smalltooth sawfish (*Pristis pectinata*), and largetooth sawfish (*Pristis pristis*).[284]

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[272] Blanco-Parra & Niño-Torres, supra note 154, at 162.
[273] Pérez-Jiménez et al., supra note 51, at 1183; Blanco-Parra & Niño-Torres, supra note 154, at 162.
[274] Blanco-Parra & Niño-Torres, supra note 154, at 162-63.
[275] Pollum et al., supra note 7, at 6.
[276] Id., citing Mejía, P.A. & A.F. Navia 2020 (unpublished data).
[277] Cruz et al., supra note 110, at 3444-45; da Silva Ferrette et al., supra note 192, at 4019.
[278] Santana et al., supra note 5.
[279] da Silva Ferrette et al., supra note 192, at 4018. Cruz et al., supra note 110, at 3438, 3439. Prior to this, numbers had been released annually since 1950. Cruz et al., supra note 110, at 3445.
[280] Cruz et al., supra note 110, at 3438.
[281] Id. at 3446.
[282] Santana et al., supra note 5, at 14.
[283] Cruz et al., supra note 110, at 3438.
[284] Pollum et al., supra note 7, at 6, citing Charvet, P. & V. Faria, Southwest Atlantic Ocean, in Harrison, L.R. & N.K. Dulvy (eds.), Sawfish: A Global Strategy for Conservation (2014), Lessa, R. et al., Close to extinction? The collapse of the endemic daggernose shark (Isogomphodon oxyrhynchus) off Brazil, 7 Global Ecology & Conservation 70 (2016), Reis-Filho et al., supra note 206.

The first shark catch ordinance in Brazil was enacted in 1998 (IBAMA N. 121/98).[285] That ordinance was updated in 2012 to prohibit finning, though it still allowed beheading and evisceration prior to landing (Normative Instruction 14).[286] As a result of the 85% decline in biomass observed in 2004 as well as the large number of juveniles caught as bycatch, the smalltail shark was listed as threatened with extinction by the Normative Instruction 05/2004.[287] Theoretically, at that point, a management plan should have been developed and implemented by 2009 and catch prohibited.[288] In reality, the smalltail shark's management plan was never implemented, the species continues to be caught, and the population has failed to recover.[289]

When Brazil began using the IUCN categories and criteria to evaluate species' conservation status in 2014, the smalltail shark was reclassified as critically endangered.[290] Specifically, the smalltail shark was listed on the Brazilian Ordinance of the Ministry of Environment no. 445 (Dec. 17, 2014), a piece of legislation that aimed to restrict the harvest and trade of species listed on the Brazilian National Red List as Critically Endangered or Endangered.[291] Pressure from the fishing industry led to its suspension during 2015 and half of 2016.[292] The industry continued to fight the legislation and challenged its applicability to marine resources in court.[293] In 2017, the Ministry of the Environment suspended the ordinance's applicability to the commercial sector until July 2018.[294] Even if it were put into effect, however, actualization of the legislative goals would be difficult given the difficulties of post-harvest species identification[295] and Brazil's refusal since 2011 to release official fishery statistics.[296] The only recent fishery information comes from Mourão et al. (2014) and Almeida et al. (2014), who recorded a threefold increase in gillnet length for fisheries off Brazil's north coast, a change that was a direct response to reduced

[285] Wosnick et al., supra note 113, at 160.
[286] Id.
[287] Santana et al., supra note 5, at 3.
[288] Id. at 14; Feitosa et al., supra note 27, at 888. Separately, the smalltail shark is listed in the National Plan of Actions (PAN-tubarões) (2014-2019), which requires the development of a species management plan. Pollum et al., supra note 7, at 6.
[289] Santana et al., supra note 5, at 14; Feitosa et al., supra note 27, at 883, 888.
[290] Santana et al., supra note 5, at 3 (stating that this reclassification resulted in part from "the recent increase in fishing effort with the use of longer gillnets spanning over 10 km, its occurrence in several different large scale fisheries for shrimp and teleosts, and its decreased national occurrence area, and lack of population increase"). See also Feitosa et al., supra note 58, at 2 (noting the development of a national plan of action for sharks and rays known as PAN-Tubarões in 2014).
[291] Pollum et al., supra note 7, at 6, citing Feitosa et al., supra note 58, at 2; Feitosa et al., supra note 27, at 888.
[292] Pollum et al., supra note 7, at 6, citing Begossi et al., supra note 138.
[293] Pollum et al., supra note 7, at 6, citing Spautz, supra note 138.
[294] Baretto et al., supra note 138.
[295] Martins et al., supra note 123; Wosnick et al., supra note 123, at 9; Santana et al., supra note 5, at 14; Rodrigues-Filho et al., supra note 61, at 406; Liu et al., supra note 113, at 2. Dried fins are nearly impossible to identify without the aid of DNA identification techniques. Id.
[296] Cruz et al., supra note 110, at 3439, 3445; Santana et al., supra note 5, at 14. This continues to occur in Brazil even though such practices are illegal. Feitosa et al., supra note 58, at 2.

fishery productivity of target species in the region.[297] Some of those gillnets now stretch to 15 km in length, placing the remaining smalltail sharks at higher risk of capture.[298]

Additional challenges relate to enforcement. Brazil's environmental agencies do not communicate effectively with fishery communities, nor do inspections occur in the region's largest fishing ports.[299] Vessel tracking systems in artisanal fisheries are scarce.[300] Fishery managers in Brazil thus have little reliable knowledge on species catch composition, making enforcement difficult if not impossible.[301] Indiscriminate catch of smalltail sharks still occurs throughout Brazil and that scenario is unlikely to change given, among other things, insufficient funding for the country's fisheries managers.[302]

Overall, fisheries regulations throughout the smalltail shark's range are insufficient to protect the species from extinction.

B. Climate Change Regulations

Regulatory mechanisms are woefully insufficient to address climate change-related threats to the smalltail shark. Existing national and international regulatory climate change mechanisms are non-binding and, even if adhered to by all parties, fail to mandate greenhouse gas emission reductions sufficient to protect sharks from climate change-related effects including ocean warming and ocean acidification. These failings are compounded by the recently enacted Inflation Reduction Act, which mandates massive oil and gas leasing in the United States.[303]

In a past analysis, NMFS concluded that "existing regulatory mechanisms with the objective of reducing [greenhouse gas (GHG)] emissions were inadequate to prevent … climate-related threats" to species.[304] With respect to international agreements, the agency found it "unlikely that Parties would be able to collectively achieve, in the near term, climate change avoidance goals outlined via international agreements."[305] In addition, "none of the major global initiatives appeared to be ambitious enough, even if all terms were met, to reduce GHG emissions to the

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[297] Mourão, K.R.M. et al., A pesca de Scomberomorus brasiliensis e alternativas para o seu manejo no litoral nordeste do Pará – Brasil, in Haimovici, M., J.M. Andriguetto Filho & P.S. Sunye (eds.), A pesca marinha e estuarina no Brasil: estudos de caso multidisciplinares (2014); Almeida, Z da S de et al., Análise multidisciplinary das pescarias de emalhe da pescada-amarela, de camarão de puçá de muruada e da catação de caranguejo uçá em três municípios costeiros do Maranhão, in Haimovici, M., J.M. Andriguetto Filho & P.S. Sunye (eds.), A pesca marinha e estuarina no Brasil: estudos de caso multidisciplinares (2014); see also Santana et al., supra note 5, at 14.
[298] Santana et al., supra note 5, at 14. See also Feitosa et al., supra note 27, at 888 (noting that fisheries targeting *C. acoupa* and *S. brasiliensis* have increased in size, putting more pressure on smalltail sharks in the region).
[299] Santana et al., supra note 5, at 14.
[300] Id.
[301] Rodrigues-Filho et al., supra note 61, at 410.
[302] Feitosa et al., supra note 27, at 888; da Silva Ferette et al., supra note 192, 4008 (2019).
[303] Inflation Reduction Act, Pub. L. No. 117-169 (2022).
[304] Nat'l Oceanic & Atmospheric Admin., U.S. Dep't of Commerce, Endangered and Threatened Wildlife and Plants: Final Listing Determination on Proposal to List 66 Reef-Building Coral Species and to Reclassify Elkhorn and Staghorn Corals, 79 Fed. Reg. 53,852 (Sept. 10, 2014).
[305] Id.

level necessary to" avoid impacts to imperiled species.[306] Circumstances on the international front have not changed materially since the agency's review.

The primary international agreement on climate action is the United Nations Framework Convention on Climate Change (UNFCCC). Adopted at the Rio Earth Summit in 1992, it has to date been ratified by 190 countries. The most recent agreement covering UNFCCC countries, the Paris Agreement, was ratified in 2016 and took effect in 2020. According to the UNFCCC, "[t]he Paris Agreement builds upon the Convention and for the first time brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects."[307] The "central aim" of the Agreement "is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius."[308]

Scientists predict increases of 2°C or more would result in "'dangerous' [to] 'extremely dangerous' climate change."[309] Projected impacts include the disappearance of Arctic summer sea ice, irreversible melting of the Greenland ice sheet, an increased risk of extinction for 20-30% of species on Earth, and "rapid and terminal" declines of coral reefs worldwide.[310] The Paris Agreement seeks to avoid such dangerous harms by aiming to limit warming to 1.5°C. Humans already have warmed the planet 1.0°C over the pre-industrial level, and at the current rate we likely will reach 1.5°C of warming between 2030 and 2052.[311]

This warming occurs largely due to rising atmospheric CO_2 levels. In 2019, the global annual atmospheric concentration of CO_2 exceeded 415 parts per million (ppm) for the first time.[312] This carbon dioxide level—a dramatic increase over the preindustrial level of 280 ppm—has not been seen for 3 million years.[313] Atmospheric CO_2 has been rising at a rate of nearly 3 ppm per year, and this rate is accelerating.[314] In 2021, global average atmospheric carbon dioxide was 414.72

[306] Id.
[307] United Nations Framework Convention on Climate Change (UNFCCC), The Paris Agreement (2020), available at https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement (last visited Jan. 23, 2020).
[308] Id.
[309] Anderson, K. & A. Bows, Beyond 'dangerous' climate change: emission scenarios for a new world, 369 Phil. Trans. Series A, Mathematical, Physical, and Engineering Sci. 20 (2011).
[310] Veron, J.E.N. et al., The coral reef crisis: The critical importance of <350 ppm CO_2, 58 Marine Pollution Bull. 1428 (2009); see also Jones, C. et al., Committed terrestrial ecosystem changes due to climate change, 2 Nature Geoscience 484 (2009); The Economics of Ecosystems and Biodiversity (TEEB), Climate Issues Update (2009); Hare, W. et al., Climate hotspots: key vulnerable regions, climate change and limits to warming, 11 Regional Envt'l Change 1 (2011); Warren, R. et al., Increasing impacts of climate change upon ecosystems with increasing global mean temperature rise, 106 Climatic Change 141 (2011); Frieler, K., et al., Limiting global warming to 2ºC is unlikely to save most coral reefs, 3 Nature Climate Change 165 (2013).
[311] Intergovernmental Panel on Climate Change (IPCC), Global Warming of 1.5°C (2018); UNFCCC, supra note 307.
[312] Harvey, Chelsea, Atmospheric CO_2 Breaks a Record. Here's Why It Matters, E&E News (May 16, 2019).
[313] Id.
[314] Id.; Raupach, M.R. et al., Global and regional drivers of accelerating CO_2 emissions, 104 Proc. Nat'l Acad. Sci. 10288 (2007); Friedlingstein, P. et al., Update on CO_2 emissions, 3 Nature Geoscience 811 (2010); Nat'l Oceanic & Atmospheric Admin. (NOAA), Global carbon dioxide growth in 2018 reached 4th highest on record (May 22, 2019), available at https://www.noaa.gov/news/global-carbon-dioxide-growth-in-2018-reached-4th-highest-on-record.

ppm—a record average high.[315] But as climate scientists have warned: "[i]f humanity wishes to preserve a planet similar to that on which civilization developed and to which life on Earth is adapted, paleoclimate evidence and ongoing climate change suggest that CO_2 will need to be reduced … to at most 350 ppm [equivalent to ~1.5°C], but likely less than that."[316] This 350 ppm target must be achieved within decades to prevent dangerous tipping points and "the possibility of seeding irreversible catastrophic effects."[317]

Despite its adoption of the 1.5°C threshold, the Paris Agreement does not do enough to shield the marine species including sharks from the harmful effects of climate change, including ocean warming and ocean acidification.[318] Additionally, signatories have not yet effected the changes necessary to achieve the Agreement's goals.[319] According to analysis released last week by the United Nations, current commitments will result in warming of approximately 2.5-2.9°C by 2100.[320] According to Simon Stiell, Executive Secretary of the United Nations Framework Convention on Climate Change, "We are still nowhere near the scale and pace of emission reductions required to put us on track toward a 1.5 degrees Celsius world."[321]

The United States took a significant step backwards on its climate change commitments when it passed the Inflation Reduction Act, which will require a massive amount of oil and gas drilling.[322] Further, in the United States, federal agencies have failed to fully capitalize on existing authority under domestic law to reduce greenhouse gas emissions to levels that would be protective of species. The U.S. government repeatedly has acknowledged that its rules do not go far enough to notably reduce the nation's greenhouse gas emissions.[323] The government's refusal to utilize existing laws such as the Clean Air Act and Energy Policy and Conservation Act to force needed greenhouse gas reductions renders them inadequate mechanisms to protect the smalltail shark from the effects of climate change.

Throughout the smalltail shark's range, regulatory mechanisms fail to protect the species from climate change, fishing, and other threats to its continued existence. Additional protections including those afforded by the Endangered Species Act will be required for the species' conservation.

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[315] Nat'l Oceanic & Atmospheric Admin., Climate change: atmospheric carbon dioxide (June 23, 2022), at https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide.
[316] Hansen, J.M. et al., Target atmospheric CO_2: where should humanity aim?, 2 Open Atmospheric Sci. J. 217 (2008).
[317] Id.
[318] See United Nations Environment Programme (UNEP), Emissions Gap Report 2019 (2019).
[319] See id.
[320] United Nations Framework Convention on Climate Change (UNFCCC), Nationally determined contributions under the Paris Agreement: Synthesis report by the secretariat 30 (Oct. 26, 2022).
[321] Schonhardt, Sara, Huge gap remains in curbing climate pollution, UN finds, Greenwire (Oct. 26, 2022).
[322] Inflation Reduction Act, Pub. L. No. 117-169 (2022).
[323] See, e.g., Nat'l Highway Traffic Safety Administration (NHTSA), Final Environmental Impact Statement: Medium- and Heavy-Duty Fuel Efficiency Improvement Program (June 2011) ("these reductions in emissions are not sufficient by themselves to reduce total [commercial medium-heavy duty on-highway vehicle and work truck] emissions below their 2005 levels by 2020"); U.S. Envt'l Protection Agency (EPA), Standards of Performance for Greenhouse Gas Emissions for New Stationary Sources: Electric Utility Generating Units, 77 Fed. Reg. 22,392, 22,401 (April 13, 2012) (conceding that this new power plant rule on greenhouse gas emissions "will not have direct impact on U.S. emissions of greenhouse gases under expected economic conditions").

5. Other Natural or Manmade Factors Affecting the Smalltail Shark's Continued Existence

Several other factors contribute to the smalltail shark's risk of imminent extinction, including climate change, the species' *K*-selected life history characteristics, and a handful of miscellaneous threats.

A. Climate Change

Climate change poses an increasing threat to the smalltail shark as ocean conditions continue to shift.[324] The world's oceans have absorbed more than 90 percent of the excess heat caused by climate change, resulting in average sea surface warming of 0.7°C (1.3°F) per century since 1900.[325] Global average sea surface temperature is projected to rise by 2.7°C (4.9°F) by the end of this century under a higher emissions scenario.[326] In addition, climate change contributes to marine heat waves—periods of extreme warm surface temperatures—which have become longer-lasting and more frequent in recent decades.[327] The number of heat wave days doubled between 1982 and 2016 and is projected to increase 23 times under 2°C warming.[328] At present, 87 percent of marine heat waves are attributable to human-induced warming.[329]

Exacerbating the harm from rising ocean temperatures is ocean acidification. The global ocean has absorbed more than a quarter of the CO_2 emitted to the atmosphere by human activities, which has increased its surface acidity by more than 30 percent.[330] This increase has occurred at a rate likely faster than anything experienced in the past 300 million years.[331] Ocean acidity could increase 150 percent by the end of the century if CO_2 emissions continue unabated.[332] By reducing the availability of key chemicals (namely, aragonite and calcite), ocean acidification negatively affects a wide range of calcifying marine creatures by hindering their ability to build

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[324] See generally Diaz-Carballido, Pedro Luis et al., Evaluation of shifts in the potential future distribution of Carcharhinid sharks under different climate change scenarios, 8 Frontiers Marine Sci. 745501 (2022) (climate change); Dulvy et al., supra note 2, at 4778 (other habitat harms).
[325] United States Global Climate Change Research Program (USGCRP), Climate Science Special Assessment: Fourth National Climate Assessment, Vol. I (2017).
[326] Id.
[327] Laufkötter, Charlotte, Jakob Zscheischler & Thomas L. Frölicher, High-impact marine heatwaves attributable to human-induced global warming, 369 Sci. 1621 (2020).
[328] Frolicher, Thomas L. et al., Marine heatwaves under global warming, 560 Nature 360 (2018).
[329] Id.
[330] Simpson et al. (2009) correlate a Caribbean open-ocean aragonite saturation state of 4.0, which is needed to protect corals from degradation from ocean acidification, with an atmospheric CO_2 level of 340 to 360 ppm—far below current levels. Simpson, M.C. et al., An Overview of Modeling Climate Impacts in the Caribbean Region with contribution from the Pacific Islands (United Nations Development Programme (UNDP), Barbados, West Indies, 2009).
[331] Hönisch, Barbel et al., The geological record of ocean acidification, 335 Science 1058 (2012); USGCRP, supra note 325.
[332] Orr, James C. et al., Anthropogenic ocean acidification over the twenty-first century and its impact on calcifying organisms, 437 Nature 681 (2005); Feely, Richard et al., Ocean acidification: Present conditions and future changes in a high CO_2 world, 22 Oceanography 36 (2009).

skeletons and by disrupting metabolism and critical biological functions.[333] Many of these organisms form the foundation of marine food webs, and their demise has ripple effects throughout entire ecosystems.

Chondrichthyans are expected to be particularly sensitive to climate change.[334] As ectothermic species, many physiological processes of sharks are affected by temperature; temperature, thus, constrains their range.[335] Tropical marine fauna are among the species "most sensitive to climate change, since the members evolved in a relatively stable thermal environment."[336] While exact thresholds remain unknown for most tropical shark species, scientists believe they may live close to their thermal limits and exhibit a reduced ability to acclimate to even slight temperature increases.[337] These species thus are expected to respond to climate change by shifting their distribution to areas that meet their physiological and biological needs,[338] but they can do so only if suitable alternative habitats are available and accessible.

A number of studies have described actual or expected climate change-induced reductions and/or shifts in range for various shark species, with significant redistributions as soon as 2050.[339] These effects are expected to be more pronounced under more severe climate change scenarios.[340] Both the ocean warming and ocean acidification associated with climate change

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[333] Fabry, Victoria J. et al., Impacts of ocean acidification on marine fauna and ecosystem processes, 65 ICES Journal of Marine Science 414 (2008); Kroeker, Kristy J. et al., Impacts of ocean acidification on marine organisms: quantifying sensitivities and interactions with warming, 19 Global Change Biology 1884 (2013).

[334] Diaz-Carballido et al., supra note 324, at 2; Dulvy et al., supra note 2, at 4778; Osgood, Geoffrey J., Easton R. White & Julia K. Baum, Effects of climate-change-driven gradual and acute temperature changes on shark and ray species, 90 J. Animal Ecology 2547 (2021).

[335] Diaz-Carballido et al., supra note 324, at 8.

[336] Id. at 2, 8 (internal citation omitted). See also Donelson, J. et al., Acclimation to predicted ocean warming through developmental plasticity in a tropical reef fish, 17 Global Change Biology 1712 (2011).

[337] Diaz-Carballido et al., supra note 324, at 8-9.

[338] See generally Hobday, Alastair J., Ensemble analysis of the future distribution of large pelagic fishes off Australia, 86 Progress Oceanography 291 (2010); Tittensor, Derek P. et al., Global patterns and predictors of marine biodiversity across taxa, 466 Nature 1098 (2010); Cheung, William W.L. et al., Climate-change induced tropicalisation of marine communities in Western Australia, 63 Marine & Freshwater Research 415 (2012); Hazen, Elliott L. et al., Predicted habitat shifts of Pacific top predators in a changing climate, 3 Nature Climate Change 234 (2013); Nakamura, Yohei et al., Tropical fishes dominate temperate reef fish communities within Western Japan, 8 PLoS ONE e81107 (2013); Cheung, William W.L. et al., Projecting future changes in distributions of pelagic fish species of Northeast Pacific shelf seas, 130 Progress Oceanography 19 (2015); Robinson, L.M. et al., Trailing edges projected to move faster than leading edges for large pelagic fish habitats under climate change, 113 Deep Sea Research Part II: Topical Studies in Oceanography 225 (2015); Fogarty, Hannah E. et al., Are fish outside their usual ranges early indicators of climate-driven range shifts?, 23 Global Change Biology 2047 (2016).

[339] See generally Jones, Miranda C. et al., Predicting the impact of climate change on threatened species in UK waters, 8 PLoS ONE e54216 (2013); Hare, Jonathan A. et al., A vulnerability assessment of fish and invertebrates to climate change on the Northeast U.S. continental shelf, 11 PLoS ONE e0146756 (2016); Lezama-Ochoa, Nerea et al., Present and future potential habitat distribution of *Carcharhinus falciformis* and *Canthidermis maculate* by-catch species in the tropical tuna purse-seine fishery under climate change, 3 Frontiers Marine Sci. 34 (2016); Gonzalez-Pestana, Adriana, Habitat suitability of juvenile smooth hammerhead shark (*Sphyrna zygaena*) off northern Peru, Thesis, James Cook Univ. (2018); Birkmanis, Charlotte A. et al., Future distribution of suitable habitat for pelagic sharks in Australia under climate change models, 7 Frontiers Marine Sci. 570 (2020); Crear, Daniel P. et al., Sensitivity of a shark nursery habitat to a changing climate, 652 Marine Ecology Progress Series 123 (2020); Tanaka, Kisei R. et al., North Pacific warming shifts the juvenile range of a marine apex predator, 11 Nature Sci. Reports 3373 (2021); Diaz-Carballido et al., supra note 324, at 15; Osgood, White & Baum, supra note 334.

[340] Diaz-Carballido et al., supra note 324, at 15.

have been shown to impact tropical shark species survival.[341] As just described, temperature has shown strong associations with distribution.[342] Changes in salinity flowing from climate change also likely will play a role in shark species' range shifts; exposure to shifts in salinity can lead to increased energy costs to maintain osmotic balance (decreased salinity) or retained salts in their blood (increased salinity).[343] Food species assemblages likewise will be impacted by climate change, with implications for shark species.[344] Shifts in ocean currents resulting from climate change also may affect shark distribution, as some shark species use currents to, *e.g.*, search for food.[345]

Researchers studying the effects of ocean acidification on elasmobranchs also have revealed some concerning associations. Dixson et al. (2014) showed that future projected CO_2 levels impaired odor tracking and attack behavior in the smooth dogfish (*Mustelus canis*).[346] Pistevos et al. (2015) found that elevated CO_2, alone or in combination with elevated temperature, harmed Port Jackson sharks (*Heterodontus portusjacksoni*) by increasing energetic demands, decreasing metabolic efficiency, and reducing sharks' ability to find food through olfaction.[347] These effects led to notable reductions in growth rate.[348] Pistevos et al. (2017) concluded that the interactive effects of ocean acidification and warming, with associated increases in energetic demand, will lead to energetic tradeoffs as sharks seek to sustain themselves in future ocean conditions.[349] Pegado et al. (2018) found that high CO_2 conditions led to significant reductions in the somatic growth rate and the amount of time juvenile white-spotted bamboo sharks (*Chiloscyllium plagiosum*) spent swimming.[350] They also found a reduction in acetylcholinesterase (AChE) activity in two areas of the brain, and warned that long-term exposure to high CO_2 levels may "reduce individual performance with cascading consequences to shark population dynamics."[351] Dziergwa et al. (2019) found that ocean acidification may lead to denticle corrosion in the demersal shark species *Haploblepharus edwardsii*, which could compromise skin protection and hydrodynamics.[352]

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[341] See Rosa, Rui et al., Early-life exposure to climate change impairs tropical shark survival, 281 Proc. Royal Soc'y B 20141738 (2014).
[342] See Diaz-Carballido et al., supra note 324, at 8; Osgood, White & Baum, supra note 334.
[343] Diaz-Carballido et al., supra note 5, at 2, 9-10.
[344] See id. at 13-14.
[345] Id. at 10, citing Ranintyari, M. et al., Effects of oceanographic factors on spatial distribution of whale shark in Cendrawasih Bay National Park, West Papua, 149 Environ. Earth Sci. 012050 (2018); Báez, J. et al., Ensemble modeling of the potential distribution of the whale shark in the Atlantic Ocean, 10 Ecology & Evolution 175 (2020); Bradie, J. & B. Leung, A quantitative synthesis of the importance of variables used in MaxEnt species distribution models, 44 J. Biogeography 1344 (2019).
[346] See generally Dixson, Danielle L. et al., Odor tracking in sharks is reduced under future ocean acidification conditions, 21 Global Change Biology 1454 (2014).
[347] See generally Pistevos, Jennifer C.A. et al., Ocean acidification and global warming impair shark hunting behaviour and growth, 5 Nature Sci. Reports 16293 (2015).
[348] Id.
[349] Pistevos, Jennifer C.A. et al., Antagonistic effects of ocean acidification and warming on hunting sharks, 126 Oikos (2017).
[350] See generally Pegado, Maria Rita et al., Reduced impact of ocean acidification on growth and swimming performance of newly hatched tropical sharks (*Chiloscyllium plagiosum*), 51 Marine & Freshwater Behaviour & Physiology 347 (2018).
[351] Id. at 347.
[352] Dziergwa, Jacqueline et al., Acid-base adjustments and first evidence of denticle corrosion caused by ocean acidification conditions in a demersal shark species, 9 Nature Sci. Reports 18668 (2019).

Climate change will impact smalltail sharks throughout their range. The northern Gulf of Mexico already is experiencing climate driven, ecological changes.[353] Some studies have found that tropical-associated species are becoming more common in the region.[354] It may be that the northern Gulf of Mexico will become an increasingly important refuge for the smalltail shark as the climate changes. Yet the future is uncertain, and models by Diaz-Carballido et al. (2022) predict significant habitat loss for sharks in the northern Gulf of Mexico with climate change.[355] *Carcharhinus porosus* experienced the highest loss in suitable habitat across its range of all the species they studied.[356] Feitosa et al. (2020) considered how a suite of environmental variables might be affected by climate change and, in turn, affect smalltail shark distribution.[357] They found water temperature to be the most important variable in terms of habitat suitability, followed by light at the bottom (a proxy for turbidity, with smalltail sharks preferring more turbid waters).[358]

In sum, the effects of climate change including ocean warming and acidification pose an increasing threat to the smalltail shark and increase the species' risk of extinction.

B. Life History Characteristics

Several life history characteristics of the smalltail shark make it susceptible to overexploitation and limit the species' ability to recover once it has been depleted. The smalltail shark exhibits *K*-selected characteristics including slow growth, a long juvenile phase and resulting late maturity, and low fecundity.[359] These factors and the smalltail shark's limited recruitment capacity make it less resilient, less productive, and particularly vulnerable to fishery overexploitation and other anthropogenic stressors.[360] In addition, the coastal smalltail shark inhabits shallower waters, which place it at higher risk of anthropogenic threats—and thus extinction—than deeper-dwelling species.[361]

Low genetic diversity adds to this constellation of threats. A low allele diversity was observed in smalltail shark specimens from the Amazon coast, suggesting that overfishing already has led to reduced genetic diversity in the species.[362] This low diversity is reinforced by the species' restricted dispersal capacity, which prevents an inflow on new genetic material from other

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353 See generally Cloyed, Carl S. et al., West Indian manatees use partial migration to expand their geographic range into the Northern Gulf of Mexico, 8 Frontiers Marine Sci. 725837 (2021).
354 See id. at 2.
355 Diaz-Carballido et al., supra note 324, at 7.
356 Id. at 8, 12-13.
357 Feitosa et al., supra note 27, at 888.
358 Id. at 888, citing Leopold, Poissons de Mer de Guyane: Guide Illustre (2004).
359 Lessa et al., supra note 11, at 388; Lessa & Santana, supra note 27, at 710; Feitosa et al., supra note 27, at 888; Santana et al., supra note 5, at 10. Santana et al. estimate generation time at 7.9 years. Id. See also Cortés, supra note 27 (estimating generation length as 8.4 years, with a range of 7.5 – 9.6 years).
360 Lessa & Santana, supra note 27, at 710; Stevens et al., supra note 114; Shepherd & Myers, supra note 64; Santana et al., supra note 5, at 10.
361 Dulvy et al., supra note 2, at 4779.
362 Santana et al., supra note 5, at 3, citing Tavares, Weydder et al., Multiple substitutions and reduced genetic variability in sharks, 49 Biochemical Systematics & Ecology 21 (2013); see also Feitosa et al., supra note 27, at 883 (noting genetic bottleneck).

populations, making it all the more vulnerable to localized fishing pressures.[363] As a result of these factors, Santana et al. (2020) call the smalltail shark "one of the most naturally at-risk species of *Carcharhinus* in the world."[364]

C. Miscellaneous Threats

A handful of miscellaneous threats also potentially add to the smalltail shark's extinction risk. Dulvy et al. (2014) list the following as additional threats to chondrichthyans in general: high habitat specificity and restricted geographic ranges; shark population control efforts due to (mis)perceived risk and fear of shark attacks; capture in shark control nets; persecution to minimize fishing net damage, shellfish aquaculture predation, and interference with fishing injury.[365] Sharks also are removed from the wild for scientific research and the aquarium trade.[366] Shark cage diving is an increasingly popular ecotourism activity and may be a contributing stressor for certain shark species.[367] These stressors, alongside fishing, climate change, and other threats, may increase the smalltail shark's risk of extinction.

Summary of Factors

The smalltail shark faces a "serious extinction threat"[368] from overfishing, and this threat is compounded by climate change, other habitat degradation and destruction, contamination, inadequate regulatory mechanisms, life history characteristics that render the species particularly vulnerable, and other miscellaneous threats. Protection under the U.S. Endangered Species Act is required to prevent the smalltail shark's extinction.

Protection of the smalltail shark under the ESA also will help protect the ecosystems inhabited by the species. In addition to conserving individual species like the smalltail shark, the Endangered Species Act is intended to "provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved."[369] Ecosystem protection will help conserve the smalltail shark, and protection of the smalltail shark will help conserve the ecosystems the species calls home.

Sharks including the smalltail play a key role in ecosystem functioning.[370] Fishing and overfishing of shark species affects populations "both directly through removals, and indirectly through modification of ecosystem trophic structure and habitat."[371] As high-level predators,

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363 Feitosa, Dressler & Lessa, supra note 30, at 9.
364 Santana et al., supra note 5, at 13.
365 Dulvy et al., supra note 119, at 5.
366 Dulvy et al., supra note 2, at 4778.
367 See Diaz-Carballido et al., supra note 324, at 2; Blanco-Parra & Niño-Torres, supra note 154, at 162, citing Gallagher, A.J. et al., Biological effects, conservation potential, and research priorities of shark diving tourism, 184 Biological Conservation 365 (2015).
368 Feitosa et al., supra note 27, at 889. See also Feitosa et al., supra note 58, at 7 (stating that "threatened shark species are being harvested throughout Brazil's North Coast, which could result in stocks collapses, local extinctions, and possibly even global extinction of some species with restricted range").
369 16 U.S.C. §1531(b).
370 See Pacoureau, supra note 111.
371 Shepherd & Myers, supra note 64, at 1101; Tavares et al., supra note 362, at 22; Liu et al., supra note 113.

sharks are situated at or near the top of marine food webs. The large-scale removal of elasmobranchs like the smalltail shark from their respective ecosystems leads not only to individual species decline but to changes in community structure and function.[372] Myers et al. (2007) report evidence of ecosystem restructuring as the result of the loss of sharks.[373] Extirpations and extinctions of shark species will have significant, negative consequences for entire marine ecosystems—ecosystems on which a number of other species, including humans, depend.

Sharks are in steep decline the world over, and the United States is no exception.[374] Many elasmobranch species in the Gulf of Mexico where the smalltail shark resides, suffered precipitous declines in the 20th century, largely as the result of industrialized fishing.[375] Shark deaths as the result of both commercial and sport fishing in the region likely are considerably underestimated.[376] As a result, "[c]oastal elasmobranch community structure has undergone significant change since the early 1970s in the northern Gulf of Mexico."[377] This has significant repercussions for the entire Gulf of Mexico ecosystem. Listing the smalltail shark under the ESA would help protect not only the species itself, but also entire ecosystems upon which the species depends.

PART IV. CRITICAL HABITAT DESIGNATION

The ESA mandates that, when NMFS lists a species as endangered or threatened, the agency concurrently designate critical habitat for that species. 16 U.S.C. § 1533(a)(3)(A)(i); *see also id*. at § 1533(b)(6)(C). This requirement is not a mere formality; it is inextricably linked to species recovery.[378] One analysis found species with designated critical habitat were more than twice as likely to be increasing in numbers than those without.[379]

The ESA defines "critical habitat" as:

> i. the specific areas within the geographical area occupied by the species, at the time it is listed . . . , 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
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> ii. specific areas outside the geographical area occupied by the species at the time it is listed … , upon a determination by the Secretary that such areas are essential for the conservation of the species.

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[372] Shepherd & Myers, supra note 64, at 1095. See also Pistevos et al., supra note 347.
[373] Myers, Ransom A. et al., Cascading effects of the loss of apex predatory sharks from a coastal ocean, 315 Sci. 1846 (2007). See also Baum, Julia K. et al., Collapse and conservation of shark populations in the northwest Atlantic, 299 Sci. 389 (2003).
[374] Myers et al., supra note 373. See also Baum et al., supra note 373 (evidencing shark decline in one ocean system).
[375] Shepherd & Myers, supra note 64, at 1095; Rodrigues-Filho et al., supra note 61, at 405.
[376] Rodrigues-Filho et al., supra note 61, at 405, citing Cortés, supra note 27.
[377] Shepherd & Myers, supra note 64, at 1100.
[378] See Taylor, Martin F.J. et al., The effectiveness of the Endangered Species Act: a quantitative analysis, 55 BioScience 360 (2005).
[379] See id.

Id. at § 1532(5)(A). The Center expects that NMFS will comply with this unambiguous mandate and designate critical habitat in U.S. waters concurrently with the listing of the smalltail shark.[380]

PART V. 4(d) AND 4(e) RULES

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) [and/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."

Should NMFS determine after conducting a status review that listing of the smalltail shark as "threatened" is warranted, the Center hereby petitions the agency to simultaneously issue a 4(d) rule outlining necessary and advisable regulations for the species' conservation.[381] The Center urges NMFS to extend to the smalltail shark all prohibitions of ESA Section 9, including the bans on taking, imports, exports, sale in interstate or foreign commerce, and transport (applying limited exceptions to promote science and restoration as provided in ESA Section 10 as needed) and to promulgate additional protective regulations needed for survival and recovery of the species. Specifically, the Center petitions NMFS to issue regulations addressing trade and greenhouse gas emissions (including as they affect ocean warming and acidification).

Further, if the smalltail shark or any distinct population segment thereof is listed as endangered or threatened, the Center requests that NMFS promulgate a 4(e) rule for species similar in appearance to the smalltail shark. Section 4(e) of the ESA provides that the Secretary may treat any species as an endangered species "even though it is not listed pursuant to this section," when

> 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). NMFS should evaluate whether the smalltail shark meets these criteria and, if so, promulgate a 4(e) rule for look-alike species.

CONCLUSION

Fishery overexploitation for meat, fins, oil, and other byproducts poses an existential threat to the smalltail shark's continued existence. This primary threat is compounded by climate change, habitat degradation and destruction, pollution, inadequate regulatory mechanisms, inherent life history characteristics, and a handful of miscellaneous threats. Collectively, these threats are

[380] See, e.g., Swift & Portnoy, supra note 83, at 797 (noting that Corpus Christi Bay may serve as essential habitat for several small coastal shark species).
[381] 16 U.S.C. § 1533(d).

driving the smalltail shark toward extinction. Protection under the U.S. Endangered Species Act is necessary for the conservation and recovery of this critically imperiled species.

The Center requests that NMFS list the smalltail shark as endangered under the ESA and designate critical habitat for the species within U.S. waters. Listing will significantly improve the species' conservation prospects by reducing key threats, increasing global awareness, catalyzing needed research, and encouraging national and international conservation partnerships. NMFS should list the smalltail shark under the ESA without delay.