A Petition to List the Smooth Hammerhead Shark (*Sphyrna zygaena*) as an Endangered, or Alternatively as a Threatened, Species Pursuant to the Endangered Species Act, Either in its own Right or due to its Similarity of Appearance to the listed Scalloped Hammerhead (*Sphyrna lewini*) Populations, and for the Concurrent Designation of Critical Habitat

Smooth Hammerhead Shark (*Sphyrna zygaena*) (Photo copyright of Elasmodiver, used with permission, *available at* http://www.elasmodiver.com/Smooth_Hammerhead_Shark_Pictures.htm).

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

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I. INTRODUCTION

Petitioner, Defenders of Wildlife ("Defenders") is dedicated to the protection of all native animals and plants in their natural communities. With more than 1.2 million members, supporters, and activists, Defenders is a leading advocate for the protection of threatened and endangered species. Defenders' 2013-2023 Strategic Plan identifies sharks as one of several categories of key species whose conservation is a priority for our organization's work.[2]

Through this Petition, Defenders hereby formally requests that the Secretary of Commerce ("Secretary"), acting through the National Marine Fisheries Service ("NMFS"), an agency within the National Oceanic and Atmospheric Administration ("NOAA"), list the smooth hammerhead shark (*Sphyrna zygaena*) as an "endangered," or alternatively as a "threatened," species under the Endangered Species Act ("ESA"). 16 U.S.C. §§ 1531–44. We request that NMFS list the species throughout its entire range, or, in the alternative, if NMFS finds that there are distinct population segments ("DPSs") of smooth hammerhead sharks, we request that those DPSs be listed under the ESA. Additionally, because the ESA's definitions of both threatened and endangered species provide for listing species that are threatened or endangered "throughout all or a significant portion of [their] range," Defenders requests that, in reviewing this Petition, NMFS specifically analyze whether the smooth hammerhead is threatened or endangered throughout all or any significant portion of its range. *See* 16 U.S.C. §§ 1532(6), (20). Furthermore, we request that NMFS designate critical habitat for the species concurrent with listing for those areas within U.S. jurisdiction. *See* 16 U.S.C. § 1533(b)(6)(C); 50 C.F.R. § 424.12. Finally, should NMFS determine not to list the smooth hammerhead and/or any DPS of the species in its own right, Defenders requests that the species, or any remaining DPS of the species, be listed in its entirety based on its similarity of appearance to the recently listed DPSs of the scalloped hammerhead (*Sphyrna lewini*) and/or to any DPS of smooth hammerheads that NMFS otherwise lists. *See* 16 U.S.C. § 1533(e); 79 Fed. Reg. 38,213 (July, 3 2014). This Petition is submitted pursuant to the ESA, 16 U.S.C. § 1533(b)(3)(A), the ESA's implementing regulations, 50 C.F.R. § 424.14, and the Administrative Procedure Act, 5 U.S.C. § 553(e).

Listing the smooth hammerhead under the ESA would be consistent with the United States' ongoing recognition of threats to the species requiring conservation measures. The United States first formally recognized that the smooth hammerhead is being overutilized in 2010 when it proposed the smooth hammerhead and four other sharks for listing under Appendix II of the Convention on International Trade in Endangered Species of Flora and Fauna ("CITES") and again in 2013 when it supported a proposal to list the smooth hammerhead and two other shark species under Appendix II of CITES (*see* E-CoP15-Prop-15 at 1-2; USFWS, 2013). The United States explained that "[t]he primary threats to these shark species are targeted and bycatch fisheries," and that the species "are harvested primarily for the international fin trade, and current catch levels are considered unsustainable." (USFWS, 2013). Therefore, consistent with, and in furtherance of, the United States' determination that the smooth hammerhead warrants CITES listing, and in recognition of the continued and growing threat to the species, including overutilization causing unsustainable smooth hammerhead population declines, NMFS should list the smooth hammerhead under the ESA.

[2] More information on Defenders' work is available on our website, https://www.defenders.org, and Defenders' 2013-2023 Strategic Plan is available at https://www.defenders.org/publications/defenders-strategic-plan-2013-2023.pdf.

Defenders anticipates that, in keeping with 50 C.F.R. § 424.14(a), NMFS will acknowledge the receipt of this Petition in writing within 30 days. As fully set forth below, this Petition contains all the information requested in 50 C.F.R. §§ 424.14(b)(2)(i)–(iv) and 16 U.S.C. § 1533(e). All cited documents are listed in the bibliography and electronic copies of these documents accompany this Petition.

II. THE ENDANGERED SPECIES ACT

G. Species and Distinct Population Segments

The ESA defines the term "species" to include "any subspecies of fish, wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." 16 U.S.C. § 1532(16). The distinct population segment ("DPS") language from this definition allows NMFS to protect species under the ESA regionally. NMFS and the U.S. Fish and Wildlife Service ("FWS") have jointly published principles for defining a DPS. 61 Fed. Reg. 4722 (Feb. 7, 1996). In order to satisfy the DPS criteria, a vertebrate species population must be discrete from other populations of the species and significant to the species. These terms are defined as follows:

> A population segment of a vertebrate species may be considered discrete if it satisfies either one of the following conditions:
>
> 1. It is markedly separated from other populations of the same taxon as a consequence of physical, physiological, ecological, or behavioral factors. Quantitative measures of genetic or morphological discontinuity may provide evidence of this separation.
>
> 2. It is delimited by international governmental boundaries within which differences in control of exploitation, management of habitat, conservation status, or regulatory mechanisms exist that are significant in light of section 4(a)(1)(D) of the Act.

61 Fed. Reg. at 4725.

> If a population segment is considered discrete under one or more of the above conditions, its biological and ecological significance will then be considered in light of Congressional guidance . . . that the authority to list DPS's be used '. . . sparingly' while encouraging the conservation of genetic diversity. In carrying out this examination, the Services will consider available scientific evidence of the discrete population segment's importance to the taxon to which it belongs. This consideration may include, but is not limited to, the following:
>
> 1. Persistence of the discrete population segment in an ecological setting unusual or unique for the taxon,

2. Evidence that loss of the discrete population segment would result in a significant gap in the range of a taxon,

3. Evidence that the discrete population segment represents the only surviving natural occurrence of a taxon that may be more abundant elsewhere as an introduced population outside its historic range, or

4. Evidence that the discrete population segment differs markedly from other populations of the species in its genetic characteristics.

61 Fed. Reg. at 4725.

Although these guidelines are "non-regulatory" and serve only as policy guidance for the agencies, 61 Fed. Reg. at 4723, the courts have upheld this policy as a "reasonable interpretation" of ambiguous language in the ESA. *See, e.g., Maine v. Norton*, 257 F. Supp. 2d 357, 385-87 (D. Me. 2003). Therefore, NMFS should use these criteria to evaluate the populations described in this petition, *infra*, should it decide not to list the smooth hammerhead species as a whole throughout its range.

H. Significant Portion of the Species' Range

The ESA defines an "endangered species" as any species which is "in danger of extinction throughout all or a significant portion of its range," 16 U.S.C. § 1532(6), and a "threatened species" as one which "is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." 16 U.'S.C. § 1532(20). The ESA does not define the meaning of a "significant portion of its range" ("SPR"). However, FWS and NOAA issued a final policy on interpretation of SPR on July 1, 2014. 79 Fed. Reg. 37,577. According to this policy, a range constitutes a "significant portion" if "the portion's contribution to the viability of the species is so important such that without the members in that portion the species would be in danger of extinction, or likely to become so in the foreseeable future, throughout all of its range." 79 Fed. Reg. at 37,580.

Under this definition, a species could only be listed under the SPR provision if NMFS 1) determined that the species is neither endangered nor threatened throughout all of its range; 2) determined the biological importance of the portion of the species range where it is facing threats to the conservation of the species; and 3) determined that impairment of this portion of the species' range would increase the vulnerability of the species to threats to the point that the entire species would be in danger of extinction, or likely to become so in the foreseeable future. 79 Fed. Reg. at 37,583. The courts have rejected this interpretation of SPR because it effectively requires that the species face a "species as a whole" extinction risk, thus reading the SPR language out of the statute. When faced with this SPR interpretation, the United States Court of Appeals for the Ninth Circuit explained:

> If . . . the effect of extinction throughout "a significant portion of its range" is the threat of extinction everywhere, then the threat of extinction throughout "a significant portion of its range" is equivalent to the threat of extinction throughout all its range. Because the statute already defines "endangered species" as those that

> are "in danger of extinction throughout all . . . of [their] range," the Secretary's interpretation of "a significant portion of its range" has the effect of rendering the phrase superfluous. Such a redundant reading of a significant statutory phrase is unacceptable.

Defenders of Wildlife v. Norton, 258 F.3d 1136, 1145 (9th Cir. 2011).

In response to the court striking down this previous SPR policy, FWS and NOAA have released a new Draft SPR Policy. 76 Fed. Reg. 76,987 (Dec. 9, 2011). However, the new Draft SPR Policy also requires that the loss of the species in the portion of its range at issue would result in a risk of extinction to the species throughout its range in order for that portion to be significant. Therefore, this new draft interpretation is similarly inconsistent with the language of the ESA and is also in violation of the Ninth Circuit's holding in *Norton*. *See* 16 U.S.C. §§ 1532(6), 20; *Norton*, 258 F.3d at 1145. However, under any reasonable interpretation of the ESA's SPR language, and even under NMFS' new overly restrictive, and likely illegal, draft policy, as discussed further below, the smooth hammerhead is endangered or threatened in at least a significant portion of its range and should therefore be listed throughout its range.

I. Listing Criteria

NMFS makes its determination of whether a species is endangered or threatened, based on the following five factors set forth in 16 U.S.C. § 1533(a)(1):

A. The present or threatened destruction, modification, or curtailment of its habitat or range;
B. Overutilization for commercial, recreational, scientific, or educational purposes;
C. Disease or predation;
D. The inadequacy of existing regulatory mechanisms; or
E. Other natural or manmade factors affecting its continued existence.

In order to be listed, a species need only face threats sufficient to support listing under a single factor. *See Humane Soc'y of the U.S. v. Pritzker*, No. 11-01414, 2014 WL 6946022, at *2 (D.D.C. Nov. 14, 2014) (citing *Sw. Ctr. For Biological Diversity v. Babbitt*, 215 F.3d 58, 60 (D.C. Cir. 2000)). However, the smooth hammerhead faces threats under all five (*see* IV. IDENTIFIED THREATS TO THE PETITIONED SPECIES: CRITERIA FOR LISTING, *supra*).

J. 90-Day and 12-Month Findings

After receiving a petition to list a species, NMFS is required to determine "whether the petition presents substantial scientific or commercial information indicating that the petitioned action may be warranted" within 90 days. 16 U.S.C. § 1533(b)(3)(A). This is called a "90-day finding." A "negative" 90-day finding ends the listing process, which is a final agency action subject to judicial review. 16 U.S.C. § 1533(b)(3)(C)(ii). A "positive" 90-day finding leads to a status review and a finding that listing the species is either warranted, not warranted, or warranted but precluded by other pending listing proposals, which is to be completed within twelve months ("12-month finding"). 16 U.S.C. § 1533(b)(3)(B).[3]

NMFS' regulations define "substantial information," for purposes of consideration of petitions, as "that amount of information that would lead a reasonable person to believe that the measure proposed in the petition may be warranted." 50 C.F.R. § 424.14(b)(1). In making a finding as to whether a petition presents "substantial information" warranting a positive 90–day finding, NMFS considers whether the petition:

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

50 C.F.R. §§ 424.14(b)(2)(i)–(iv). NMFS' own guidance on "substantial information" states that the information presented should merely be "adequate and reliable,"[4] not conclusive.

K. Reasonable Person Standard

Both the language of NMFS' regulation, by setting the "reasonable person" standard for substantial information, and the relevant case law underscore the point that the ESA does *not* require "conclusive evidence of a high probability of species extinction" in order to support a positive 90-day finding. *Ctr. for Biological Diversity v. Morgenweck*, 351 F. Supp. 2d 1137, 1140 (D. Colo. 2004); 50 C.F.R. § 424.14(b)(1). In reviewing negative 90-day findings, the courts have consistently held that the evidentiary threshold under a 90-day review is much lower than the one required under a 12-month review. *See, e.g.*, *Ctr. for Biological Diversity v. Kempthorne*, No. CV 07-0038-PHX-MHM, 2008 WL 659822, at *8 (D. Ariz. Mar. 6, 2008) ("[T]he 90-day review of a listing petition is a cursory review to determine whether a petition contains information that warrants a more in-depth review."); *see also Pritzker*, 2014 WL 6946022, at *5-7 (holding that NMFS was arbitrary and capricious when it determined that conflicting evidence or "some level of uncertainty" was sufficient to show that the petitioner had failed to provide "substantial evidence" that listing was appropriate at the 90-day finding stage); *Moden v. U.S. Fish & Wildlife Serv.*, 281 F. Supp. 2d 1193, 1203 (D. Or. 2003) (holding that the substantial information standard is defined in "non-stringent terms" and that "the standard in reviewing a petition . . . does not require conclusive evidence.").

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[3] Like 90-day findings, these 12-month findings are also made under a "substantial information" standard, and determinations that listing is either not warranted or that it is warranted but precluded are also subject to judicial review. 16 U.S.C. §§ 1533(b)(3)(B), (C)(ii).
[4] FWS & NMFS, PETITION MANAGEMENT GUIDANCE (1996), *available at* http://www.nmfs.noaa.gov/op/pds/documents/02/110/02-110-06.pdf.

In fact, courts have characterized the 90-day finding determination as a mere "threshold determination" and have held that the ESA contemplates a "lesser standard by which a petitioner must simply show that the substantial information in the Petition demonstrates that listing of the species *may* be warranted." *See Pritzker*, 2014 WL 6946022, at *8 (quoting *Colo. River Cutthroat Trout v. Kempthorne,* 448 F. Supp. 2d 170, 176 (D.D.C. 2006)); *Morgenweck*, 351 F. Supp. 2d at 1141 (quoting 16 U.S.C. § 1533(b)(3)(A) (emphasis added)); *see also Ctr. for Biological Diversity v. Kempthorne*, No. C 06-04186 WHA, 2007 WL 163244, at *3 (N.D. Cal. Jan. 19, 2007) (holding that in issuing negative 90-day findings for two species of salamander, FWS erroneously applied "a more stringent standard" than that of the reasonable person). Thus, a petition does not need to establish that there is a high likelihood that the species is either threatened or endangered at the 90-day finding stage.

In addition,

> The 'may be warranted' standard . . . seems to require that in cases of . . . contradictory evidence, the [agency] must defer to information that supports petitioner's position. It would be wrong to discount the information submitted in a petition solely because other data might contradict it. At [the 90-day finding] stage, unless the [agency] has demonstrated the *unreliability* of information that supports the petition, that information cannot be dismissed out of hand.

Kempthorne, 2007 WL 163244, at *4 (emphasis added). In fact, the court in *Pritzker* determined that NMFS' need for more conclusive information in that case was itself sufficient to suggest a reasonable person "might conclude 'a review of the status of the species concerned' was warranted." 2014 WL 6946022, at *5. NMFS' failure to provide a positive 90-day finding and complete a status review was thus found to be arbitrary and capricious. 2014 WL 6946022, at *5-7.
Finally, NMFS itself has acknowledged this reduced burden multiple times. For instance, NMFS has stated that, when evaluating a 90-day petition, it does not "subject the petition to critical review." 71 Fed. Reg. 66,298 (Nov. 14, 2006). NMFS has also acknowledged that past judicial decision have established that "a petition need not establish a 'strong likelihood' or a 'high probability' that a species is either threatened or endangered to support a positive 90-day finding." 79 Fed. Reg. 4877, 4878 (Jan. 30, 2014).[5]

L. Best Available Scientific and Commercial Data

NMFS is required to make an ESA listing determination for the smooth hammerhead under the listing criteria based exclusively on the best scientific and commercial data *available*. *See* 16 U.S.C. § 1533(b)(1)(A); 50 C.F.R. § 424.11(b). Therefore, similar to the substantial information determination, NMFS cannot deny listing merely because there is little information available if the best *available* information indicates that the smooth hammerhead is threatened or endangered under any one, or any combination, of the five ESA listing criteria.[6] This is particularly important under a

[5] While the 12-month finding is also based on a substantial information standard, it is made after the benefit of a status review, which can help to resolve uncertainty and contradictory evidence. *See* 16 U.S.C. § 1533(b)(3)(B).
[6] *See City of Las Vegas v. Lujan*, 891 F.2d 927, 933 (D.C. Cir. 1989) ("[Section 4] merely prohibits the Secretary from disregarding available scientific evidence that is in some way better than the evidence he relies on. Even if the available scientific and commercial data were inconclusive, he may – indeed

90-day review since, as noted above, NMFS must make a positive finding and commence a status review when a reasonable person would conclude based on the *available* evidence that listing may be warranted. *See, e.g., Pritzker*, 2014 WL 6946022, at *5-7.

The International Union for the Conservation of Nature ("IUCN") is the world's oldest and largest global environmental network and has become a leading authority on the environment (IUCN Undated – 2). It is a neutral, democratic membership union with more than 1,200 government and non-governmental organization ("NGO") members, and almost 11,000 volunteer scientists and experts in more than 160 countries (IUCN Undated – 2). Its work is supported by over 1,000 professional staff in 45 offices and hundreds of partners in public, NGO, and private sectors around the world (IUCN Undated – 2).

As part of its work, the IUCN compiles and updates the IUCN Red List, "the definitive international standard for species extinction risk . . ." (IUCN, Undated – 2). The IUCN Red List assessments are recognized internationally, are relied on in a variety of scientific publications, and are used by numerous governmental and non-governmental organizations. The IUCN Red List has also been used to inform multi-lateral agreements, such as CITES, the Convention on Migratory Species ("CMS"), and the Convention on Biological Diversity. As a result of the scientific rigor with which these Red List determinations are made, both NMFS and FWS have utilized IUCN data and Red List listing determinations when making ESA listing decisions even though the IUCN Red List criteria differ from the ESA's statutory requirements for listing a species as endangered or threatened. This is because the IUCN is considered a credible source of scientific data that meets the "best available science" requirement of the ESA. *See* 16 U.S.C. § 1533(b)(3)(A). NMFS' reliance on these findings is further supported by a recent study that found that, with respect to marine fish species, IUCN Red List listings were not biased towards exaggerating threat status and that IUCN Red List listings can serve as an accurate flag for relatively data-poor fisheries (Davies & Baum, 2012 at 7). In fact, based on the listing criteria that must be evaluated and applied, the IUCN Red List is arguably an even more objective evaluation of a species' extinction risk than the more subjective narrative criteria used in the ESA listing process.

One example of NMFS' reliance on these Red List determinations comes from its decision to list the Guadalupe fur seal as a threatened species. In that decision, NMFS specifically noted that,

> The Guadalupe fur seal is listed by IUCN as "vulnerable." Included in this category are species "believed likely to move into the 'Endangered' category in the near future . . ." and species whose populations "have been seriously depleted and whose ultimate security has not yet been assured." This classification corresponds more closely with the ESA definition of "threatened" than "endangered" and therefore, it

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must – still rely on it at this stage…"); *Trout Unlimited v. Lohn*, 645 F. Supp. 2d 929, 950 (D. Or. 2007) ("[T]he agency 'cannot ignore available biological information'") (citing *Kern Co. Farm Bureau v. Allen*, 450 F.3d 1072, 1080-81 (9th Cir.2006)); *In re Polar Bear Endangered Species Act Listing and 4(d) Rule Litigation*, 794 F. Supp. 2d 65, 106 (D.D.C. 2011) ("As this Court has observed, 'some degree of speculation and uncertainty is inherent in agency decisionmaking' and 'though the ESA should not be implemented 'haphazardly' . . . an agency need not stop in its tracks when it lacks sufficient information.'") (citing *Oceana v. Evans*, 384 F. Supp. 2d 203, 219 (D.D.C. 2005)).

appears that the "threatened" status is consistent with the IUCN category of vulnerable.

50 Fed. Reg. 51,252, 51,254 (Dec. 16, 1985).[7]

Through such actions, NMFS has repeatedly recognized the IUCN Red List as a legitimate source of information on species endangerment. However, in addition to a general recognition of IUCN data and determinations as a source of the best available information on extinction risk, the Guadalupe fur seal decision is important for another reason as well. With regard to the Guadalupe fur seal, NMFS noted the IUCN's "vulnerable" extinction risk determination for the species and applied the corresponding ESA listing status, "threatened." Similar to the Guadalupe fur seal, the IUCN Red List classifies the smooth hammerhead as a "vulnerable" species throughout its range (Casper, *et al.*, 2005). Therefore, the IUCN determination should be sufficient to at least list the species as a whole as threatened under the ESA. However, this Red List determination is a decade old at this point, with threats to the species continuing since then (Casper, *et al.*, 2005). Therefore, this threat assessment is likely conservative and at least some populations, or even the species as a whole or the species within a significant portion of its range, may now qualify under the more stringent ESA definition of an "endangered" species. *See* 16 U.S.C. § 1532(6).

III. SPECIES DESCRIPTION

A. Common Name

This Petition will refer *Sphyrna zygaena* by the common name "smooth hammerhead" throughout. Other common names include: common hammerhead, common hammerhead shark, common smooth hammerhead shark, round-headed hammerhead, and round-headed hammerhead shark (Bester, Undated).

B. Taxonomy

The taxonomy of *Sphyrna zygaena* is as follows:

Kingdom	*Animalia*
Phylum	*Chordate*
Subphylum	*Vertebrata*
Class	*Chondrichthyes*
Subclass	*Elasmobranchii*

[7] *See also, e.g.,* 77 Fed. Reg. 26,478, 26,481 (May 4, 2012) (dwarf seahorse 90-day finding, citing IUCN reports and findings); 90-Day Finding on a Petition To List Nassau Grouper as Threatened or Endangered, 77 Fed. Reg. 61,556, 61,561 (Oct. 10, 2012) (Nassau grouper 90-day finding, citing IUCN reports and findings); 77 Fed. Reg. 73,220, 73,253 (Dec. 7, 2012) (proposed listing determination for 82 coral species, citing IUCN reports and findings); 77 Fed. Reg. 76,740, 76,748 (Dec. 28, 2012) ("These [IUCN Red List] listings highlight the conservation status of listed species and can inform conservation planning and prioritization."); 75 Fed. Reg. 70,169, 70,170 (Nov. 17, 2010).

Order	*Carcharhiniformes*
Family	*Sphyrnidae*
Genus	*Sphyrna*
Species	*zygaena*

Figure 1. Smooth hammerhead taxonomy (Integrated Taxonomic Information System, 2015).

The Integrated Taxonomic Information System indicates that the taxonomic status of *Sphyrna zygaena* is "valid" (Integrated Taxonomic Information System, 2015).

C. Physical Characteristics

The smooth hammerhead reaches a maximum length of 16 feet (5 meters) and a maximum weight of 880 pounds (400 kilograms) (Bester, Undated).

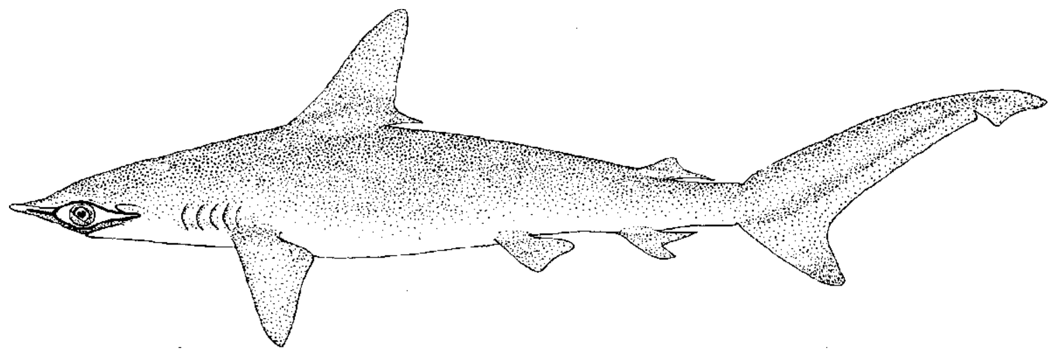

Figure 2. Sketch of smooth hammerhead **(**Compagno, 1984 at 553).

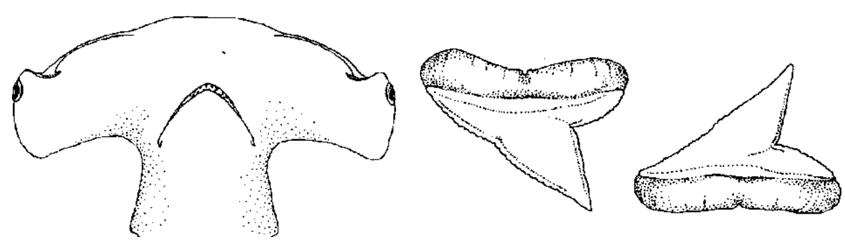

Figure 3. Sketch of smooth hammerhead head and teeth (Compagno, 1984 at 554).

The smooth hammerhead gets its common name from its large hammer-shaped head (Bester, Undated). This compressed head (cephalophoil) allows for easy distinction of hammerheads from other types of sharks (Bester, Undated). This hammer-shaped head also provides the smooth hammerhead with a wider lateral search area and improves maneuverability, which helps it capture prey (Hayes, 2007 at 2). The smooth hammerhead's cephalophoil is scalloped with a depression opposite each nostril (Hayes, 2007 at 2). Its mouth is ventrally located and is strongly arched (Hayes, 2007 at 2). The smooth hammerhead's body coloring ranges from dark olive to greyish brown and fades into a white underside (Bester, Undated; E-CoP16-Prop-43). The body's denticles are densely arranged with w-shaped posterior margins (Bester, Undated).

Compagno, 1984 at 553–54, which is incorporated by reference rather than restated, provides a much more elaborate description of the physical characteristics of the smooth hammerhead.

D. Habitat and Range

The smooth hammerhead is an active, coastal-pelagic and semi-oceanic hammerhead that is found worldwide in temperate to warm waters (Compagno, 1984 at 554). It moves away from the equator in the summer months and towards the equator in the winter (Hayes, 2007 at 55). It is found close inshore, including bays and estuaries, some freshwater rivers, over continental shelves, around coral reefs, and offshore (Compagno, 1984 at 554). The smooth hammerhead prefers shallow waters from 0 to at least 65 feet (20 meters) in depth but has been reported in depths from 65 to 650 feet (20 to 200 meters) deep (Bester, Undated; Compagno, 1984 at 554).

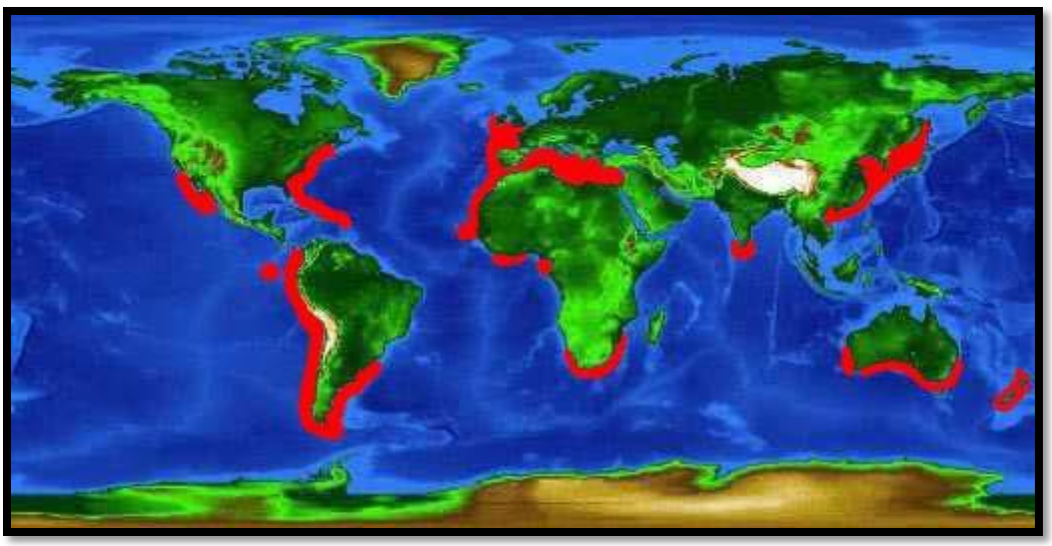

Figure 4. Global distribution of the smooth hammerhead (Bester, Undated).

Smooth hammerhead populations occur in portions of the Atlantic, Indian, and Pacific oceans, as well as in the Mediterranean Sea (Casper, *et al.*, 2005). In the Northeast Atlantic, the smooth hammerhead's range includes the entire Mediterranean coast and the British Isles through Senegal and Cape Verde Islands to Guinea and then includes a discontinuous range covering all or part of Liberia, the Ivory Coast, Ghana, Cameroon, Nigeria, Equatorial Guinea, and Gabon (Compagno, 1984 at 554; IUCN, Undated). In the Northwest Atlantic, the shark's range extends from Nova Scotia to Florida and into the Caribbean Islands (Compagno, 1984 at 554; Bester, Undated). In the Southwest Atlantic, the smooth hammerhead's range extends from southern Brazil to southern Argentina (Compagno, 1984 at 554; Bester, Undated). In the Indian Ocean, the shark ranges from South Africa to southern Mozambique (the South African portion also includes a small area in the Southeast Atlantic), from southern India to Sri Lanka, and the West and Southwest coasts of Australia (Compagno, 1984 at 554; Bester, Undated). In the Western Pacific, the smooth hammerhead's range includes the stretch from Viet Nam to southern Japan and southern Siberia and also includes the East and Southeast coasts of Australia and the New Zealand coast. In the Eastern Pacific, the smooth hammerhead's range extends from Northern California through the Gulf of California and down to the State of Nayarit in Mexico and also includes Panama, Columbia, the

Galapagos Islands, and Ecuador through to southern Chile (Compagno, 1984 at 554; Bester, Undated; IUCN, Undated).

E. Feeding

Smooth hammerheads feed on a variety of boney fish, including herring, menhaden, sea catfishes, sea bass, Spanish mackerel, and porgies (Compagno, 1984 at 554). The species also feeds on small sharks, skates, stingrays, shrimp, crabs, barnacles, and squid and other cephalopods and commonly scavenges from nets and hooks (Compagno, 1984 at 554).

F. Reproduction and Lifespan

The smooth hammerhead, like many sharks, is a "K-selected" species. This means that it matures late in life and produces relatively few young (Hayes, 2007 at 2). Smooth hammerhead longevity is estimated at around 18 years (ICCAT, 2012 at 13), but they may live to be 20, or possibly more, years old (Casper, *et al.*, 2005). Female smooth hammerhead sharks reach sexual maturity at an average age of 9 years, while males reach sexual maturity slightly earlier (ICCAT, 2012 at 13). This correlates to a size at sexual maturity of around 8.7 feet (2.7 meters) for females and 8.2-8.7 feet (2.1-2.5 meters) for males (E-CoP16-Prop-43 at 42). Like all species of hammerhead sharks, the smooth hammerhead is viviparous with a yolk-sac placenta and gives birth to live young (Bester, Undated; Hayes, 2007 at 2). The gestation period is approximately 10-11 months with a reproductive periodicity of 1 year (Bester, Undated; ICCAT, 2012 at 13). Smooth hammerheads give birth to between 20 and 40 pups, with the mean litter size being 33.5 pups (Compagno, 1984 at 554; ICCAT, 2012 at 13). At birth, pups average about 20 inches (0.5 meters) in length (Bester, Undated; Compagno, 1984 at 554).

G. Population Trend[8]

The smooth hammerhead's population is declining worldwide as a result of a variety of threats, the most serious of which is commercial fishing pressure from both directed shark fisheries and bycatch in several non-shark fisheries (Casper, *et al.*, 2005).

1. Northeast Atlantic and Mediterranean Sea

In the Northeast Atlantic, the smooth hammerhead's range includes the entire Mediterranean coast and the British Isles through Senegal and Cape Verde Islands to Guinea and then includes a discontinuous range covering all or part of Liberia, the Ivory Coast, Ghana, Cameroon, Nigeria, Equatorial Guinea, and Gabon (Compagno, 1984 at 554; IUCN, Undated).

In the early 1900s, hammerhead (*Spyrna* spp.) catches and sightings, including smooth hammerhead catches and sightings, in the Mediterranean were regular, but after 1963 no hammerheads of any kind were caught or seen in coastal areas (Ferretti, *et al.*, 2008 at 957). Camhi, *et al.*, 2007 estimates that hammerheads (*Sphyrna* spp.), including the smooth hammerhead, in the Mediterranean have

[8] Should NMFS decide to consider the smooth hammerhead in DPSs under the ESA, then Defenders requests that it consider using the regions/populations as outlined and delimited in this section in that analysis.

declined by over 99% since the early 1900s (Camhi, *et al.*, 2007 at 29; *see also* E-CoP16-Prop-43 at 1 (indicating that declines of the hammerhead shark complex in the Mediterranean were up to 99.9% since the early 19th century)). In a different report, scientists determined that the smooth hammerhead has "virtually disappeared from the central-southern Mediterranean Sea since 1986" (Casper, *et al.*, 2005). As a result, smooth hammerheads are "functionally extinct" in the Mediterranean (Ferretti, *et al.*, 2008 at 960), representing an extreme population decline. With smooth hammerheads becoming increasingly rare in this region, the likelihood that they will survive to reproductive age and be able to find a suitable mate is likely decreasing exponentially, which may cause the species to begin to decline even more quickly as it enters the extinction vortex.[9]

While population trends for the Northeast Atlantic are generally not available, there is evidence of significant hammerhead exploitation in this region (*see generally* Zeeberg, *et al.*, 2006). Zeeberg et al. (2006) suggested that population declines, similar to those for hammerheads (grouped) documented in the northwest Atlantic, could be expected in the northeast and eastern central Atlantic. "This is because longline fleets in these areas exert comparable fishing effort, and effort is seen to shift from western to eastern Atlantic waters." (E-CoP16-Prop-43 at 9 (citing Buencuerpo, *et al.*, 1998; Zeeberg, *et al.*, 2006)). Since the smooth hammerhead appears to have declined by at least 91% from 1981–2005 in the Northwest Atlantic (Hayes, 2007 at ii, 65), with declines both before and after that period from historical population numbers being extremely likely, the best available scientific information indicates that the smooth hammerhead has likely experienced similar declines in the Northeast Atlantic, with additional declines occurring both before and after the period covered by that dataset (*see* III. G. 2. Northwest Atlantic, *infra*).

2. Northwest Atlantic

In the Northwest Atlantic, the smooth hammerhead's range extends from Nova Scotia to Florida and into the Caribbean Islands (Compagno, 1984 at 554; Bester, Undated). This region, therefore, includes a large amount of U.S. coastline. Species-specific fisheries data for the smooth hammerhead in the Northwest Atlantic is typically unavailable as the hammerhead catch data is generally aggregated at the genus level. However, the overall hammerhead species decline data, discussed below, are based on catch data that is composed mainly of smooth, scalloped, and great hammerheads. Therefore, it follows that the smooth hammerhead's decline is likely at least proportional to the estimated declines of the hammerhead genus as a whole (*see* Baum & Blanchard, 2010 at 230). However, the species-specific information that does exist shows that the smooth hammerhead's decline is in fact even greater than the declines experienced by the other hammerhead species in this region (*see* Hayes, 2007 at ii, 65).

Hammerheads are subject to extensive longline fishing pressure in the Northwest Atlantic, which has led to various estimated declines in abundance. One study looking at U.S. pelagic longline logbook data from the Northwest and Western Central Atlantic indicates that the hammerhead complex there (composed of smooth, scalloped, and great hammerheads, with a majority of

[9] An extinction vortex is the point at which "[e]nvironmental, demographic and genetic factors can interact and reinforce each other in a downward spiral" increasing a species' likelihood of extinction in the short term (*see* Blomqvist, *et al.*, 2010 at 1). This extinction vortex issue likely exists for many of the other populations of smooth hammerhead as well and should be considered when determining whether to list the species.

scalloped hammerheads making up the catch) declined in abundance by 89% between 1986 and 2000 (*see* Camhi, *et al.*, 2007 at 29; Baum, *et al.*, 2003 at 389-90). Another study focusing on just the Northwest Atlantic estimated a 76% decline in *Sphyrna* spp., which includes the smooth hammerhead, between 1992 and 2005 (Baum & Blanchard, 2010 at 229, 236). However, the species-specific information for the smooth hammerhead in U.S. waters indicates even more dire declines. While Hayes, 2007 noted a 90% decline for *Sphyrna* spp. from 1981-2005 in the U.S. Atlantic and Gulf of Mexico, the study noted a slightly higher 91% decline in smooth hammerheads specifically over the same time period in those waters (Hayes, 2007 at ii, 65). These population decreases are so severe that, in 2005, the smooth hammerhead population in this region was at a mere 24% of the necessary size to provide a maximum sustainable yield (Hayes, 2007 at 54). Since smooth hammerheads are already less abundant in these waters than other hammerhead species, their declines are even more alarming and indicate that the population is likely now very small and will only be able to recover from correspondingly small losses in the future (*see* Camhi, *et al.*, 2007 at 29; Baum, *et al.*, 2003 at 389-90 (catch composed mostly of scalloped hammerheads); Baum & Blanchard, 2010 at 229, 236 (smooth hammerheads represented just 15 of the 850 identified hammerheads in the dataset for this region with scalloped hammerheads representing another 742)).

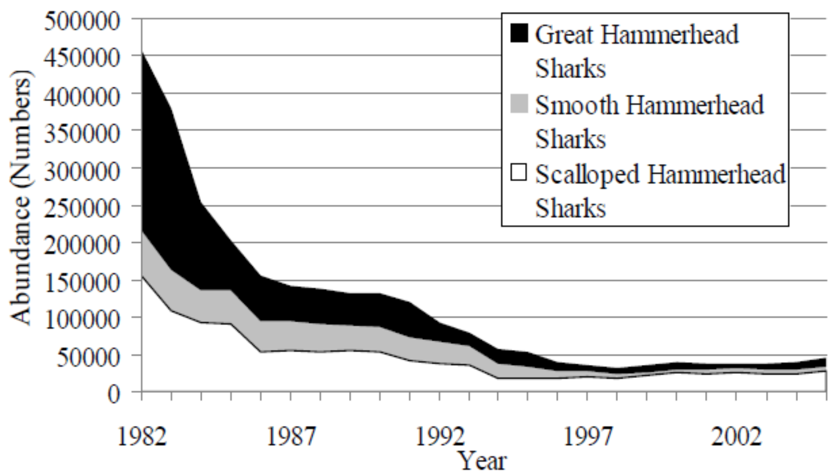

Figure 5. Population abundance estimates of the great, smooth, and scalloped hammerheads in the Northwest Atlantic and Gulf of Mexico (Hayes, 2007 at 112).

Additionally, it is worth noting that none of the decline estimates referenced for this region assess population levels for any period before 1981 (*see* Hayes, 2007 (1981-2005); Camhi, *et al.*, 2007 (1986-2000); Baum, *et al.*, 2003 (1986-2003); Baum & Blanchard, 2010 (1992-2005)). Given that intensive fishing in this region began long before 1981, the start date of the earliest dataset used in these decline estimates, these population decline figures likely significantly underestimate the decline the smooth hammerhead experienced from historical abundance. Additionally, none of these studies assess population trends after 2005. Since intensive fishing has continued in this region in the 10 years after the datasets that these studies rely on were compiled, the species' decline has likely continued, further increasing the smooth hammerhead's actual decline over the declines reported in these studies.

In addition to information on the species' historical decline, data from 1981–2005 indicates that the smooth hammerhead will likely face significant difficulty recovering to a state where it is not considered overfished in this region even if catch were eliminated entirely. Hayes, 2007 indicates that, if fishing pressure remained at 2005 levels, the species would have less than a 50% chance of recovery over 30 years and that this likelihood of recovery only increases to 64% over 30 years even if catch is entirely eliminated (Hayes, 2007 at 78). This indicates that the smooth hammerhead faces a more difficult recovery than the scalloped hammerhead, which Hayes, 2007 found was likely to recover in only 10 years, even if scalloped hammerhead catch remained at 2005 levels (Hayes, 2007 at ii-iii).

Time horizon	No Catch	C_{2005}	200% of C_{2005}	300% of C_{2005}
10 Years	11	6	3	1
20 Years	42	30	19	10
30 Years	64	47	29	17

Figure 6. Probability (percent) of smooth hammerhead shark population recovery to the point where it is no longer considered overfished over 10, 20, and 30 years in the Northwest Atlantic and Gulf of Mexico under a no catch regime and with equal, double, and triple catch levels as compared to catch from 2005 ("C_{2005}") (Hayes, 2007 at 78).

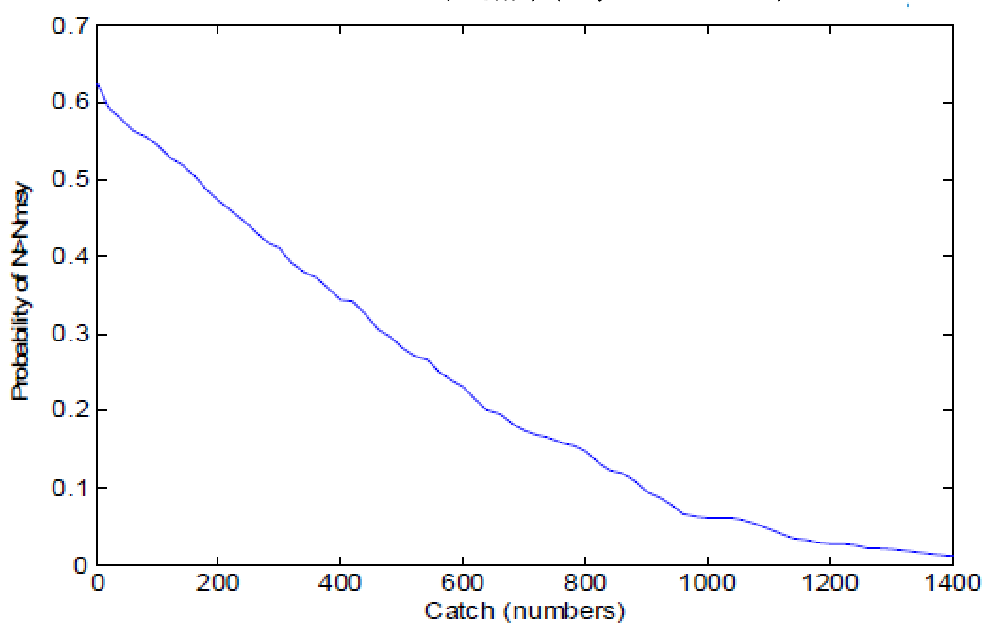

Figure 7. Probability (with 0.1 equaling 10% and 0.7 equaling 70%) of the number of smooth hammerhead individuals in the Northwest Atlantic and Gulf of Mexico outnumbering the number of smooth hammerhead individuals required to provide for a maximum sustained yield of the species in this region (an indication that the species is not overfished) in 30 years depending on the level of catch (Hayes, 2007 at 85).

In sum, the smooth hammerhead is facing an ongoing pattern of heavy declines in the Northwest Atlantic. In fact, the only species-specific data in this region indicates that the smooth hammerhead declined in U.S. waters by 91% over a 24 year period. Not only does the amalgamated hammerhead catch data support this decline data, but all of the studies referenced above likely underestimate the actual smooth hammerhead decline from historical numbers as they do not assess the population-level effects of intensive fishing occurring before 1981 or after 2005. Therefore, the species has likely experienced far greater than 91% declines in the Northwest Atlantic from historical numbers. These declines have made recovery in this region over the short term, and out to at least 30 years, unlikely without large scale reductions in catch moving forward. The available information also shows that ongoing killing of even relatively modest numbers of individuals will drastically reduce the likelihood that the species can recover from the decline that it has already experienced.

3. Southwest Atlantic

In the Southwest Atlantic, the smooth hammerhead's range extends from southern Brazil to southern Argentina (Compagno, 1984 at 554; Bester, Undated). Intensive fishing pressure throughout all stages of the smooth hammerhead's lifecycle has caused extensive declines in the species' population in this region (Casper, *et al.*, 2005). Though catch data is not available for the entirety of this area, the catch data that does exist shows extreme declines in both catch and catch per unit of effort ("CPUE").

The intensive fishing pressure off the coast of Brazil, for example, has caused an estimated CPUE decline of over 80% for the hammerhead shark complex in this area from 2000 to 2008 with declines appearing to be more highly focused, and thus to exceed this CPUE decline, in nearshore environments, such as those occupied by the smooth hammerhead, than in those occurring farther out to sea, areas where smooth hammerheads would be less likely to be present (*see* E-CoP16-Prop-43 at 9 (citation omitted)). This reduction only partially overlaps with the previous over 80% reduction in CPUE that was observed from 1995 to 2005 off the south coasts of Brazil (E-CoP16-Prop-43 at 9). In fact, the Rio Grande do Sul area in Brazil may have experienced a nearly 2/3 decline in CPUE from 2000 to 2002 alone (E-CoP16-Prop-43 at 10). The available data also indicates large declines in the southern Brazilian State of Santa Catarina.

> Industrial landings of the hammerhead shark complex (mainly [smooth and scalloped hammerheads, with scalloped hammerheads making up 80% of the hammerhead catch in southeast Brazil]) in the State of Santa Catarina . . ., were of 6.7 t[ons] in 1989, coming to a peak of 570 t[ons] in 1994, due to the fast development of net fishing. Later a decrease occurred to 202 t[ons] in 1998, 353 t[ons] in 2002 and 381 t[ons] in 2005. Lastly, in 2008, production reached only 44 t[ons] without ever recovering any more to the levels of 1994.

(E-CoP16-Prop-43 at 9 (citation omitted)). This data indicates that catch in Santa Catarina appears to have declined by over 92% between 1994 and 2008. Furthermore, these catch reductions do not appear to be based on reduction in effort as *Sphyrna* species CPUE reductions of 96% and 93% from bottom gillnet and longline vessels in Santa Catarina respectively have been observed (E-CoP16-Prop-43 at 9). Finally, since smooth hammerheads are already less abundant in these waters than other hammerhead species, their declines are even more alarming and indicate that the population is likely now very small and will only be able to recover from correspondingly small losses in the future. This lesser abundance of smooth hammerheads in these waters is also apparent in studies indicating that smooth hammerhead neonates were outnumbered by scalloped hammerhead neonates by between 20 and 100 fold in Brazil's waters from 1983 to 2005 (*see* Casper, *et al.*, 2005).

While some uncertainty as to the exact rate of smooth hammerhead decline exists over this region, the best available data indicates that both catch (>92% decline over 14 years in one area and approximately 65% decline in just two years in another (E-CoP16-Prop-43 at 9, 10)) and CPUE (multiple overlapping CPUE declines at both national and more local levels of 80–96%) have been declining in the Southwest Atlantic. Additionally, because none of the studies assess population statistics before 1989, when intensive fishing was already ongoing, or after 2008, after which intensive fishing has continued, even these extreme declines are likely conservative estimates. Furthermore, since the smooth hammerhead is already less numerous in this region, its extinction risk from the loss of individuals will increase more quickly than for more abundant species.

4. Eastern Pacific

In the Eastern Pacific, the smooth hammerhead's range extends from Northern California through the Gulf of California and further South to the State of Nayarit in Mexico and also includes Panama, Columbia, the Galapagos Islands, and Ecuador through to southern Chile (Compagno, 1984 at 554; IUCN, Undated). In the Eastern Pacific, smooth hammerheads suffer from both targeted catch and from being retained as bycatch in artisanal and industrial fisheries with a high proportion of catches being juveniles, and, in particular, female juveniles (Casper, *et al.*, 2005).

A study assessing the effects of the fishery south of the Tres Marias Islands, an island chain off the west coast of the Mexican State of Nayarit, reported that the smooth hammerhead was the most abundant out of 10 species of sharks caught and made up 35% of the recorded shark landings in 1995–96 (Casper, *et al.*, 2005 (citation omitted)). However, the artisanal fishing fleet targeting smooth hammerheads in this area has not been able to catch smooth hammerheads south of the Tres Marias Islands or in the Central Gulf of California since the late 1990s, indicating a severe decrease in the smooth hammerhead population in this region or even local extirpation (Casper, *et al.*, 2005 (citation omitted)). In addition to this localized data, there has also been an observed decrease in CPUE in the Mexican Pacific Ocean of over 84% for the closely related scalloped hammerhead from 1987–99 (E-CoP16-Prop-43 at 10). Given the similarity of these species, both physiologically and in their susceptibility to overexploitation, and their overlapping range, the smooth hammerhead has likely experienced similar declines in these waters.

Large declines are also evident in Ecuador where

> catch records for [smooth, scalloped, and great hammerheads] combined indicated a peak in landings of approximately 1000 t[ons] in 1996, followed by a decline through 2001. Landings of [scalloped hammerheads] caught by artisanal longline and driftnet fleets in the Port of Manta (which accounts for 80% of shark landings in Ecuador) were about 160 t[ons] in 2004, 96 t[ons] in 2005, and 82 t[ons] in 2006, a decline of 51% [in just three years].

(E-CoP16-Prop43 at 11 (citations omitted)). These amalgamated hammerhead and scalloped hammerhead decline figures serve as a proxy for smooth hammerhead declines in Ecuador during this period as well. Furthermore, there is anecdotal evidence of significant population declines in the Eastern Pacific with divers and dive guides in the Galapagos noting a "severe decrease in shark number and schools of hammerhead sharks." (Casper, *et al.*, 2005 (citation omitted)).

In addition, to the country-specific data above, regional data also show similar declines: "[t]he incidental catches of [smooth hammerheads] by tuna vessels which use purse seine nets in the East Pacific . . . peaked at 1,205 in 2004 and declined to 436 in 2011." (E-CoP16-Prop43 at 11 (citations omitted)). This shows a nearly 2/3 decline in catch in just seven years. While this data is not presented in terms of CPUE, intensive fishing pressure continues in this region and thus the declines in catch are likely the result of population declines and not reductions in effort.

In sum, the smooth hammerhead has experienced large declines in this region, ranging from likely local extirpation near the Tres Marias Islands and in the Central Gulf of California to 51% declines in Ecuador from 2004 to 2006 alone and 64% decline in the Eastern Pacific generally from 2004 to 2011. Based on this data, the smooth hammerhead is undergoing a continued decline in the Eastern Pacific. Additionally, similar to other time limited datasets discussed above, because these studies only began after intensive fishing was already ongoing in the region and because the studies ended in the midst of ongoing intensive fishing, the observed declines are likely conservative estimates of actual historic declines.

5. Indo-West Pacific

In the Indian Ocean, the smooth hammerhead's range is constrained to southern India, Sri Lanka, the West and Southwest coasts of Australia, and the South African coast continuing up into southern Mozambique in the Indian Ocean[10] (Compagno, 1984 at 554; Bester, Undated; Casper, *et al.*, 2005). In the Western Pacific, the species' range extends from Viet Nam to southern Japan and southern Siberia and also includes the East and Southeast coasts of Australia and the entire New Zealand coastline (Compagno, 1984 at 554; Bester, Undated; Casper, *et al.*, 2005). Throughout this area, the smooth hammerhead is caught in both artisanal and commercial fisheries as either directed or retained incidental catch. However, the fisheries data in this region is aggregated for hammerheads, or often just sharks generically, and generally does not account for smooth hammerheads separately (Casper, *et al.*, 2005). Finning and discarding of carcasses has been reported in the Indian Ocean, and a recent review of fisheries in the Indian Ocean reported that sharks are fully to over-exploited there (Casper, *et al.*, 2005). This finning is extensive and includes both legal and extensive illegal directed shark catch (Camhi, *et al.*, 2007 at 29; Casper, *et al.*, 2005). In addition, finning and retention of sharks is extremely common in the West Pacific waters that are managed by the Western and Central Pacific Fisheries Commission ("WCPFC"), an area which includes all of the smooth hammerhead's range in the Western Pacific (*see* Clarke, *et al.*, 2012 at 205-06; Bester, Undated). For example, though species-specific information is lacking, from 1998 to 2008, the percentage of sharks finned in WCPFC waters remained between 45% and 70% around Australia and New Zealand (Clarke, *et al.*, 2012 at 206). Fishing pressure is likely causing population declines throughout the Indo-West Pacific based on the extent of fishing, the species' response to such pressures throughout the rest of its range, and the smooth hammerhead's categorization as fully to over-exploited here (Casper, *et al.*, 2005).

[10] This South African coastline portion of the population includes a small area in the Southeast Atlantic, which represents the only occurrence of the species in the Southeast Atlantic (*see* Bester, Undated; Casper, *et al.*, 2005). This small area should be considered part of this population.

Where trend information does exist in this region, it is indicative of smooth hammerhead population decline. Information on shark catch from the Queensland Shark Control Program, which was based on a 44-year dataset, found that the catch rates of all species of hammerheads have decreased by more than 85% in the Cairns and Townsville regions since the onset of the Program (E-CoP16-Prop-43 at 11). There was also a 50-75% decline in CPUE for all hammerhead species in the Western Australia North coast shark fishery from 1997/1998 to 2004/2005 (E-CoP16-Prop-43 at 11). In addition, in its scalloped hammerhead listing decision, NMFS noted that

> estimates of the decline in Australian hammerhead abundance range from 58-85 percent. [CPUE] data from the northern Australian shark fishery indicate declines of 58-76 percent in hammerhead abundance in Australia's northwest marine region from 1996-2005. Data from protective shark meshing programs off beaches in New South Wales (NSW) and Queensland also suggest significant declines in hammerhead populations off the east coast of Australia. From 1973 to 2008, the number of hammerheads caught per year in NSW beach nets decreased by more than 90 percent, from over 300 individuals to fewer than 30. Similarly, data from the Queensland shark control program indicate declines of around 82 percent in hammerhead shark abundance between the years of 1985 and 2012 . . . These shark control programs were assessed to have at least a medium causative impact on the localized depletions of scalloped hammerhead sharks.

79 Fed. Reg. at 38,216 (internal citations omitted).

Juvenile smooth hammerheads inhabit coastal nursery grounds around the South African coast in large numbers. Consequently, large numbers of small smooth hammerheads are caught in gillnets set up to protect beaches in this area (*see* Diemer, *et al.*, 2011 at 236). One study documented a 64% decline in individuals of the closely related scalloped hammerhead species in these nets deployed off the beaches of Kwa-Zulu Natal, South Africa from 1978 to 2003, indicating a likely similar decline in smooth hammerheads in the area (*see* E-CoP16-Prop-43 at 11 (citation omitted)). Newborn smooth hammerheads are also likely caught, with resultant high post-capture mortality rates, by prawn fishery vessels in this area (*see* Diemer, *et al.*, 2011 at 236). These juvenile fatalities have led to observed hammerhead declines in the closely related scalloped hammerhead, indicating likely comparable smooth hammerhead declines as well. For example, prawn trawlers operating on the Tugela Bank in South Africa caught 3,288 newborn scalloped hammerheads in 1989, but this number plummeted to only 1,742 newborn scalloped hammerheads in 1992, a decline of over 47% in just three years (E-CoP16-Prop-43 at 11 (citation omitted); *see also* Diemer, *et al.*, 2011 at 229 (identifying a decline in newborn scalloped hammerheads in this area, which also likely indicates a decline in smooth hammerhead newborns as they are subjected to similar pressures)).

In addition to these incidental catches, the smooth hammerhead is also caught in targeted and recreational fisheries off the South African coast, which has contributed to the species' decline there (*see* Diemer, *et al.*, 2011 at 229). For example, "[a] study of directed shark fisheries at two sites in southwest Madagascar[, which reflects targeting of this population,] during 2001-2002 showed that hammerhead sharks represented 29% of sharks caught and 24% of the total wet weight, but species specific data are not available because fishermen do not differentiate between *S. lewini* and *S. zygaena*." (E-CoP15-Prop-15 at 10 (citation omitted)). This amalgamated catch data, while not including trend information, shows significant targeting of the species in these waters. However, in addition to showing significant smooth hammerhead targeting, competitive shore-based angling events targeting sharks in South Africa did document a considerable decline in amalgamated hammerhead catches between 1977 and 2000 (*see* Diemer, *et al.*, 2011 at 230 (citation omitted)). And, in addition to these legal catches, illegally operating longlining vessels in this area also take individuals (*see* Diemer, *et al.*, 2011 at 229). Overall, the available data "suggests that the numbers of *S. zygaena* off the east coast of South Africa decreased [from 1984-2009]." (Diemer, *et al.*, 2011 at 236).

Therefore, although there is some scarcity of species-specific and country-specific data for this region, the best available science indicates that all hammerheads, which would include the smooth hammerhead, have experienced serious declines in the Indo-West Pacific.

IV. IDENTIFIED THREATS TO THE PETITIONED SPECIES: CRITERIA FOR LISTING

The smooth hammerhead meets all five of the criteria for listing identified in the ESA. *See* 16 U.S.C. § 1553(a)(1). NMFS cannot deny listing merely because there is little information available if the best *available* information indicates that the smooth hammerhead is threatened or endangered under any one, or any combination, of the five ESA listing criteria. *See* 16 U.S.C. § 1533(b)(1)(A); 50 C.F.R. § 424.11(b). The following information represents the best available science as to the smooth hammerhead and shows that it warrants listing. *See* 16 U.S.C. § 1533(b)(3)(A). NMFS should view these threats both individually and cumulatively when assessing the smooth hammerhead's endangerment to determine whether the synergistic impacts of these threats is greater than their individual additive impacts would otherwise be.[11]

A. The present or threatened destruction, modification, or curtailment of its habitat or range[12]

Smooth hammerheads are already being seriously affected by pollutants in their environment that bioaccumulate and biomagnify to tremendously high levels in their system due to their high trophic position, long life, and large size. Due to these factors, mercury concentrations in fish muscle tissue can range from one to ten million times the concentration of the corresponding aquatic environment (Walker, 2011 at 4). These pollutants are having a variety of negative physiological impacts on the smooth hammerhead and their continued proliferation in the oceans as a result of anthropogenic activities represents both a current and future threat to the species' habitat. Furthermore, the impacts of these pollutants are often synergistic and will therefore have a compounded effect in excess of what their isolated effects would be. Mercury and polychlorinated biphenyls ("PCBs") are specifically assessed in this Petition. However, NMFS should consider the impacts of these, as well as other, pollutants on the smooth hammerhead's habitat during a status review.

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[11] Similar concerns led NMFS to list four DPSs of scalloped hammerhead (*Sphyrna lewini*), which is closely-related to the smooth hammerhead, under the ESA, two as endangered and two as threatened. *See* 79 Fed. Reg. 38,213.

[12] NMFS should also consider these pollutant-based impacts under ESA listing criterion E, "other natural or manmade factors affecting its continued existence" and, to the extent that these pollutants cause or exacerbate disease or predation of the smooth hammerhead, criterion C, "disease or predation." *See* 16 U.S.C. § 1533(a)(1).

1. Mercury

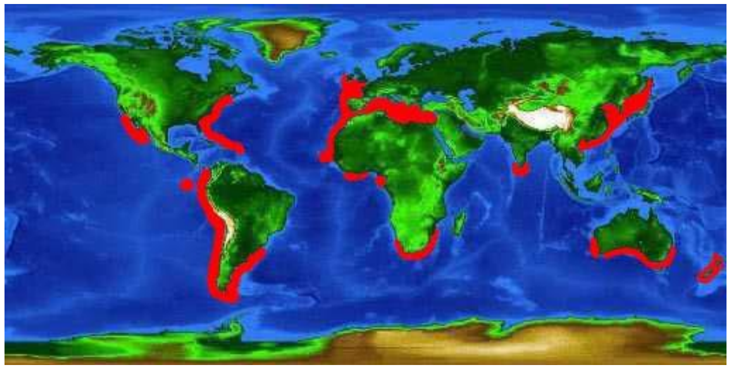
Mercury is released into the environment from industrial emissions, including those from coal-fired power plants and other sources. Presence of mercury in sharks is problematic because of the host of neurological and other problems that result. On average, mercury accumulates to levels a million times higher in the bodies of predatory fish than in the atmosphere (Geiger, 2011 at 7). In addition to sharks' high trophic position, this high level of accumulation is due in part to the combination of sharks' slow growth-rates and longevity (*see, e.g.,* Lyle, 1984 at 447). In fact, one study showed that levels of mercury increase exponentially with size (Lyle, 1984 at 445). The smooth hammerhead reaches a maximum length of up to 16 feet and potentially lives to 20 or more years of age (Casper, *et al.*, 2005). The smooth hammerhead is therefore particularly susceptible to mercury accumulation and has been observed with exceptionally high levels of mercury in its tissue (*see* Storelli, *et al.*, 2003). While studies to date have typically focused on mercury impacts to humans and creation of seafood safety standards to avoid such impacts, as discussed, *infra*, this mercury accumulation is likely causing severe reactions in the smooth hammerhead as well.

Accumulation of mercury appears to vary significantly by region and shark species and studies looking at mercury accumulation indicate that hammerheads may be particularly efficient accumulators of mercury. One of the few studies to look specifically at mercury levels in hammerheads discovered that the hammerhead species studied had among the highest mercury concentrations of any of the sharks tested, with levels ranging from 0.21 to nearly 5 mg/kg (Lyle, 1984 at 443). The upper value is nearly 10 times the National Health and Medical Research Council standard for mercury in seafood of 0.5 mg/kg (Lyle, 1984 at 441). It is also worth noting that Lyle's study is from 1984 and that oceanic mercury concentrations rose about 30% between 1989 and 2009 (*see* Cone, 2009 at 1). This rise in oceanic mercury has likely caused the smooth hammerhead to also have a consequent rise in its mercury concentration since that time. Garcia-Hernandez, *et al.*, 2007 offers further support for the proposition that hammerheads retain mercury at higher levels than other sharks. This study compared mercury levels in samples of a variety of sharks, rays, and skates in the Gulf of California and found that, not only did the smooth hammerhead exceed the Mexican national limit for mercury in seafood, but that the species in fact had the highest mercury concentration of any of the sharks, rays, or large pelagic fish tested. Another study looking at mercury levels in the smooth hammerhead, this time on the Pacific Ocean side of Baja California, found mercury concentrations in the muscle of this shark ranged from 0.005 to 1.93 mg/kg, nearly doubling the Mexican seafood standard for some of the sharks (*see* Escobar-Sanchez, *et al.*, 2010 at 479; Garcia-Hernandez, *et al.*, 2007 (Mexican seafood standard is 1 mg/kg)). Yet another study looking at mercury concentrations in the closely-related, but smaller, bonnethead shark (*Sphyrna tiburo*) in the Florida Keys and Gulf of Mexico found 0.22 to 1.78 mg/kg of mercury in the sharks' muscle tissue, with 36% of the specimens exceeding the U.S. Environmental Protection Agency's 0.49-0.94 mg of mercury per month seafood standard for a 70 kg person (Walker, 2011 at 11 (indicating these concentrations, the standard, and that shark size and total mercury concentrations are closely correlated)). This information shows that, while mercury concentration in smooth hammerheads will vary by region, the species is already experiencing concentrations in excess of those experienced by other species, that these concentrations have rendered them multiple times over the food safety limits imposed by various governmental organizations, and that, as discussed *infra*, these mercury concentrations are likely causing them to experience significant negative impacts from resultant mercury poisoning.

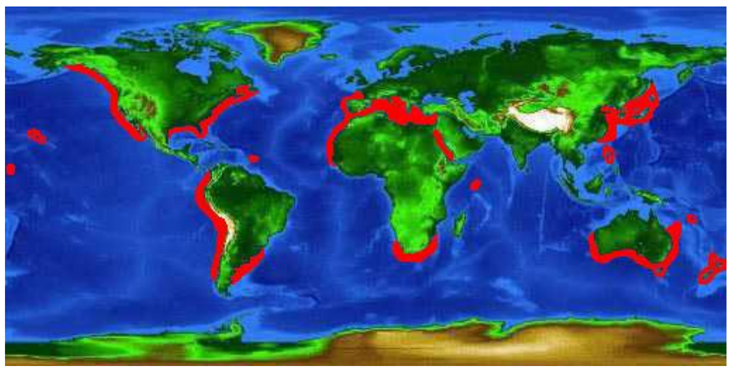
The smooth hammerhead's mercury accumulation problems are likely exacerbated, as compared to many other species, by their habitat. The rate at which fish accumulate mercury from surrounding waters increases with rising water temperatures (Lyle, 1986 at 318). Since the smooth hammerhead inhabits warm and temperate waters, it will accumulate mercury more quickly than cold water shark species (Compagno, 1984 at 554). Also, since the smooth hammerhead is typically found close inshore (Compagno, 1984 at 554), it will likely be exposed to increased concentrations of anthropogenic mercury due to its resultant proximity to human populations and their mercury emissions. This problem will only increase as more mercury is released into the oceans through runoff and atmospheric deposition and as ocean temperatures increase due to anthropogenic climate change.

Adult smooth hammerheads are also passing mercury on to their unborn young. Since smooth hammerheads are viviparous, female sharks directly transfer nutrients, and consequently mercury, through the placenta to ova and embryos (*see* Bester, Undated; Hayes, 2007 at 2; Walker, 2011 at 5). One study found that the closely-related great hammerhead had embryonic mercury concentrations of between 0.29-0.39 mg/kg, close to both the aforementioned 0.5 mg/kg Australian standard for seafood and the lower end of the EPA's 0.49-0.94 mg/month for a 70 kg person standard, even though they were still only in the embryonic stage (Lyle, 1986 at 318-19; Walker, 2011 at 11). Again, because this study is from 1986 and mercury concentrations in the ocean have increased by at least 30% since then, it is likely that there has been a corresponding increase in mercury concentrations in hammerhead embryos as well (*see* Cone, 2009 at 1).

These high mercury concentrations are likely causing the smooth hammerhead to experience a variety of ailments. A study of great white sharks tested in the Southern California Bight, an area also inhabited by the smooth hammerhead, indicated a physiological response to high levels of mercury found in the shark's muscle that could lead to behavioral alterations, emaciation, cerebral lesions, and impaired sexual development (Mull, *et al.*, 2012 at 73). The authors of that study concluded that high levels of heavy metals and organic contaminants may cause sharks to suffer lower survival or future reproductive impairment (Mull, *et al.*, 2012 at 73; *see also* Walker, 2011 at 5 (citing studies finding that a shark species, spiny dogfish (*Squalus acanthias*), exposed to mercury exhibited "decreased spermatogonial proliferation in the testis and inhibited chloride secretion in the rectal gland . . . " and that teleosts exposed to mercury exhibited "impaired gonadal development, emaciation, behavioral alterations, decreased sperm motility, . . . cerebral lesions . . . renal and hepatic lesions, neurochemical alterations, and changes in bloodplasma chemistry.") (citations omitted)). Due to the commonalities between great white sharks and smooth hammerheads (including large size, longevity, high trophic position, and very similar range), the threats to the smooth hammerhead should be assumed to be similar to those experienced by the great whites from this study (*see* Walker, 2011 at 1, 4 (mercury concentration correlated with size in closely related bonnethead shark (*Sphyrna tiburo*), high trophic position, and location)). However, while the effects to smooth hammerheads are likely similar, the intensity of those effects may even be slightly greater since, where the species' habitat does diverge, the smooth hammerhead lives in warmer waters than the great white, thus allowing it to take up mercury more rapidly (Lyle, 1986 at 318; *see also* Figure 8, *infra*).



Smooth Hammerhead



Great White

Figure 8. Maps indicating the similar ranges for the smooth hammerhead (top, Bester, Undated) and great white shark (bottom, Bester, Undated - 3) with the major differences being a more northerly distribution of great whites in the Northeast Pacific and the great white's apparent preference for water of greater depths.

One of the largest contributors to oceanic mercury is industrial emissions, including coal-fired power plants (Cone, 2009 at 1). In fact, burning of fossil fuels is the single largest source of mercury pollution in the world (MSNBC, 2009 at 1). With burning of fossil fuels increasing, mercury levels in the ocean have risen about 30% over the last 20 years (Cone, 2009 at 1). A study conducted by scientists from Harvard University and the U.S. Geological Survey predicts that the amount of mercury found in the Pacific Ocean will reach double 1995 levels by 2050 under current emission rates (Cone, 2009 at 1). This trend suggests that the threat that mercury poses to the smooth hammerhead's habitat will continue to increase in the future.

2. PCBs

The worldwide contamination of the oceans by PCBs is "of great concern due to their toxic effects on humans and wildlife. PCBs constitute a class of 209 compounds with differential biological activity and toxicity. . . ." (Storelli, *et al.*, 2003 at 1035). These PCBs produce neurotoxic and endocrine-disrupting effects that can have serious impacts on animals that ingest them (Storelli, *et al.*, 2003 at 1035).

PCBs accumulate in the fat of sharks and are present in sharks throughout the world. Storelli, *et al.*, 2003 found very high levels of PCBs in smooth hammerheads, especially in the sharks' liver tissue (Storelli, *et al.*, 2003 at 1037). The profile of PCBs in the sharks' bodies exhibited a higher proportion of more chlorinated PCBs in both muscle and liver tissues (Storelli, *et al.*, 2003 at 1037). This concentration of more chlorinated PCBs poses significant neurological dangers for smooth hammerheads, as PCBs with two or more ortho-chlorines are thought to produce neurotoxic effects (Storelli, *et al.*, 2003 at 1035). Therefore, the PCBs present in the highest quantities in smooth hammerheads are also those most likely to cause neurological problems for sharks.

In addition, recent laboratory animal studies suggest that mercury neurotoxicity can be exacerbated by the presence of PCBs (Storelli, *et al.*, 2003 at 1035, 1037 (citations omitted)). Therefore, since both neurotoxins are present in large quantities in smooth hammerheads, the risks to the species are greater than the risks posed by each neurotoxin separately. As the study indicates, "the presence of PCBs and methylmercury, coupled with their synergistic activity, may make these organisms susceptible to long-term toxic effects." (Storelli, *et al.*, 2003 at 1037).

In addition to neurological impairment, PCBs have also been cited at the likely cause of a variety of additional pathological changes in other marine animals including pneumonia, liver fibrosis, arthrosis, abscesses in muscles, lungs and other organs, skin lesions, reduced fertility, and heavy attacks from parasites (*see* Hammond, *et al.*, 2008). As a result, smooth hammerheads are likely experiencing reduced individual fitness, population decline, and synergistic impacts with other pollutants and parasites.

Since these chemicals are already present in the oceans, and will continue to be deposited there over time, PCBs represent both and present and future threat to the smooth hammerhead's habitat, particularly because the smooth hammerhead's shallow depth preference puts them in closer contact with PCB-laden silt and atmospheric deposition from land-based sources (*see* Mull, *et al.*, 2012).

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

The main threat to the smooth hammerhead is the historical and continued catch of the species in both targeted fisheries and incidentally as bycatch. Even where the smooth hammerhead is caught incidentally, it is often retained due to the species' high commercial value or is returned to the ocean dead or dying as a result of its high post-catch mortality. Smooth hammerheads are caught by a variety of fishing gears, including pelagic longlines, handlines, gillnets, purse-seines, and pelagic and bottom trawls (Amorim, *et al.*, 2011 at 2124). Because the smooth hammerhead is caught with a wide variety of gears in both coastal and oceanic fisheries, as bycatch and a target, all size classes and reproductive stages are susceptible to capture in some areas (Camhi, *et al.*, 2007 at 29). Hammerhead catch data show an increasing trend of smooth hammerhead catch since the 1990s, with the highest volume of catches in 2010 (Food and Agriculture Organization, 2012 at 82). The most comprehensive catch statistics available are for the West Central Pacific, East Indian Ocean, and East Central Pacific (Food and Agriculture Organization, 2012 at 82). However, recent sources criticize the Food and Agriculture Organization ("FAO") database on which these catch statistics are based, finding the FAO database, "the only source for current international catch statistics, may be drastically under-representing global shark catches" by as much as three to four times the actual catch (NMFS, 2013 at 50 (as much as three times); Clarke, *et al.*, 2006b at 1115 (as much as 3-4 times)). Therefore, while this data is useful in showing trends indicating increasing catch, total catch amounts are *much* higher. This discrepancy appears to be primarily a result of illegal, unreported, and unregulated fishing, which is adversely affecting the smooth hammerhead (*see* NMFS, 2013 at 66-69).

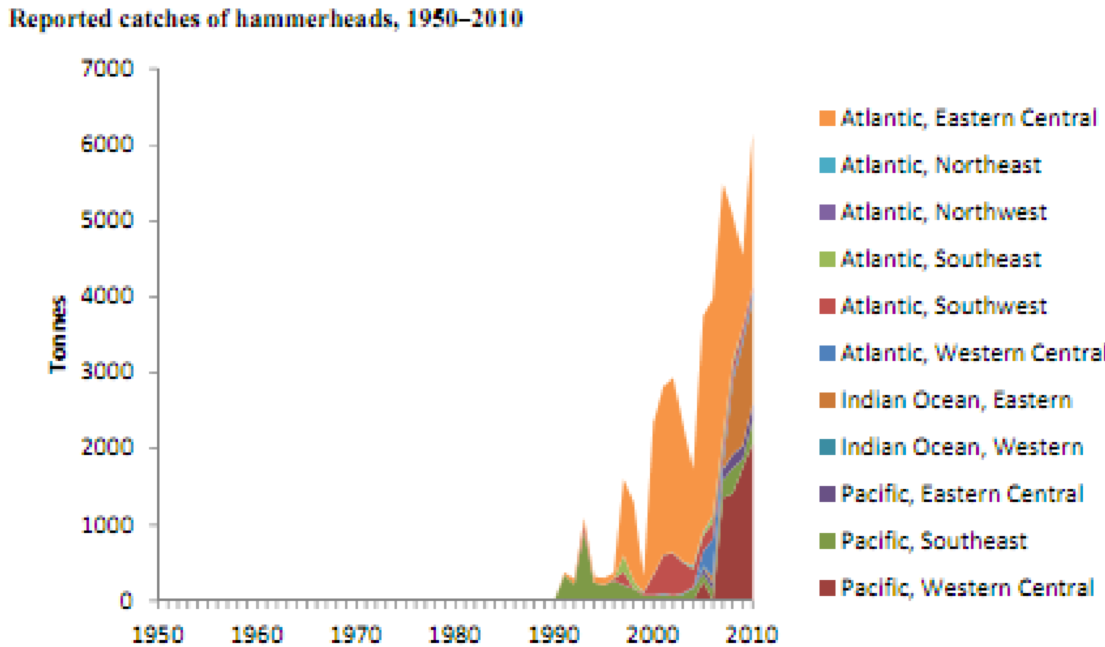


Figure 9. Reported catches of hammerheads from 1950-2010 (Food and Agriculture Organization, 2012 at 50).

Smooth hammerheads are often finned with their carcasses discarded at sea (Casper, *et al.*, 2005). It is estimated that between 1.3 and 2.7 million smooth and scalloped hammerhead sharks are killed for the shark fin trade annually (Casper, *et al.*, 2005). In other words, the smooth and scalloped hammerhead's annual biomass in the shark fin trade alone ranges from 49,000 to 90,000 metric tons annually (Casper, *et al.*, 2005). The smooth hammerhead's fins in particular are highly valued (Casper, *et al.*, 2005; Camhi, *et al.*, 2007 at 29), with hammerhead fins in general retaining the highest value in the international fin trade (Amorim, *et al.*, 2011 at 2124). As a result, targeting of the species is increasing to meet demand and the smooth and scalloped hammerhead sharks' fins represent at least 4-5% of all fins in the Hong Kong fin trading market (*see* Amorim, *et al.*, 2011 at 2124; Camhi, *et al.*, 2007 at 29). The smooth hammerhead's fins are valued over other shark fins because of their high fin ray count (Amorim, *et al.*, 2011 at 2124). In fact, "[a]ccording to shark fin traders, hammerheads . . . are one of the sources for the best quality fin needles for consumption . . ." (NMFS, 2013 at 13 (citing Abercombie, *et al.*, 2005)). As a result, the smooth hammerhead's fins sold for $88/kg in the Hong Kong market in 2003, with prices likely increasing since then (*see* E-CoP16-Prop-43 at 18 (citation omitted)). However, fin consumption is not limited to Asia alone. In fact, one study found that both smooth and scalloped hammerhead fins were showing up in shark fin soup for sale in the United States as recently as August 2012 (E-CoP16-Prop-43 at 18).

In some areas, like Latin America, Europe, and Japan, the smooth hammerhead's meat is also consumed, but fins, not meat steaks, are driving the majority of fishing pressure (*see* Mundy-Taylor & Crook, 2013 at 13). However, smooth hammerhead meat does have a higher value than that of the scalloped or great hammerheads, so its contribution to fishing pressure should not be discounted entirely (*see* Amorim, *et al.*, 2011 at 2124).

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

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

Figure 10. Chart indicating that hammerhead meat and fins are frequently used, with these fins being the second most popular in the Hong Kong fin market, the world's biggest shark fin market, and that hammerheads are preferred species for skin and liver oil (Camhi, *et al.*, 2007 at 20).

Furthermore, even where bycaught individuals are released and not finned or otherwise retained, the smooth hammerhead typically dies when caught, even if it is released. Physiological disturbances resulting from fishing activities on released bycatch species have a potential for increased population declines (Gallagher, *et al.*, 2012 at 13). Hammerhead sharks in particular show "extreme disruptions in physiological condition and increased post-mortality in response to fishing pressure" (Gallagher, *et al.*, 2012 at 13). In the Northwest Atlantic, post-release mortality is estimated to be 91.4% and 93.8% for scalloped and great hammerheads, respectively (Camhi, *et al.*, 2007 at 28-29). Cortés, *et al.*, 2010 assessed smooth hammerhead post-capture mortality in one fishery, the Atlantic pelagic longline fishery, and found that the species had the third highest post-capture mortality rate of the eleven species surveyed with 85% mortality observed (Cortés, *et al.*, 2010 at 32). Because of its physiological similarity to the great and scalloped hammerheads, this slight difference in observed post-capture mortality percentage may not reflect an actual lesser susceptibility to post-capture mortality and may instead be due to the limited fishing methods surveyed by Cortés, *et al.*, 2010. In fact, Cortés, *et al.*, 2010 provided very similar vulnerability rankings between the petitioned smooth hammerhead and the federally-listed scalloped hammerhead species, indicating a very close, or in some cases identical, level of vulnerability to fishing by the assessed fleets (Cortés, *et al.*, 2010 at 32; Figure 11, *infra*). Regardless, based on any of the post-capture mortality figures referenced above, the smooth hammerhead typically dies when caught, even if released.

ICCAT fleet	Species											Effort
	BTH	BSH	ALV	LMA	OCS	PST	POR	SPL	SMA	FAL	SPZ	
USA	5	5	2	4	5	3	5	3	4	5	4	274.6
Venezuela	3	4	1	5	3	5	6	7	5	4	7	67.3
Brazil	4	3	5	3	4	1	6	2	3	3	2	226.3
Uruguay	6	6	3	6	6	4	3	5	6	6	6	3.0
Portugal	2	2	5	2	2	5	2	4	2	2	3	429.4
Namibia	7	7	5	7	6	5	4	6	7	6	5	22.8
Combined	1	1	4	1	1	2	1	1	1	1	1	10 531.6

Figure 11. Vulnerability rankings for eleven species in six fisheries with smaller numbers indicating higher risk. Smooth hammerheads are abbreviated "SPZ" and scalloped hammerheads are abbreviated "SPL" (Cortés, *et al.*, 2010 at 32 (effort = millions of hooks from 1950-2005)).

The smooth hammerhead has already suffered, and continues to suffer, serious commercial fishing pressure from directed shark fisheries, including those off the East and West Coasts of the United States, Brazil, Spain, Taiwan, south-western Australia, western Africa, and the Philippines, and as a result of being caught as retained bycatch in numerous non-shark fisheries, especially pelagic longline and gillnets fisheries operating near continental shelves (*see* Casper, *et al.*, 2005). Some of these fisheries include the South Pacific driftnet fishery, Mediterranean drift net fishery, Spanish longline fishery, and the Indian Ocean tuna longline fishery (Casper, *et al.*, 2005).

The United States formally recognized this overutilization threat to the smooth hammerhead in 2010 when it proposed the smooth hammerhead, scalloped hammerhead, great hammerhead, sandbar shark, and dusky shark for listing under Appendix II of the Convention on International Trade in Endangered Species of Flora and Fauna ("CITES") and again in 2013 when it supported a proposal to list the smooth hammerhead, scalloped hammerhead, and great hammerhead under Appendix II of CITES (*see* E-CoP15-Prop-15 at 1-2; USFWS, 2013). The United States explained that "[t]he primary threats to these shark species are targeted and bycatch fisheries," and that the species "are harvested primarily for the international fin trade, and current catch levels are considered unsustainable." (USFWS, 2013). Therefore, consistent with, and in furtherance of, the United States' determination that the smooth hammerhead warrants CITES listing, and in recognition of the continued and growing threat of overutilization causing unsustainable smooth hammerhead population declines, NMFS should list the smooth hammerhead under the ESA.

1. Northeast Atlantic and Mediterranean Sea

In the Northeast Atlantic, the smooth hammerhead's range includes the entire Mediterranean coast and the British Isles through Senegal and Cape Verde Islands to Guinea and then includes a discontinuous range covering all or part of Liberia, the Ivory Coast, Ghana, Cameroon, Nigeria, Equatorial Guinea, and Gabon (Compagno, 1984 at 554; IUCN, Undated).

In the Northeast Atlantic and Mediterranean, the major threat to the smooth hammerhead is as retained bycatch from longlines and gillnets in the tuna and swordfish fisheries (Casper, *et al.*, 2005) (although there is a ban on driftnetting in the Mediterranean, the practice continues). A study of the Moroccan driftnet fleet operating in the southwest Mediterranean indicated that pelagic fishing pressure in that area was beyond the reproductive capacity of several shark species (Casper, *et al.*, 2005). Although the study did not specifically mention smooth hammerheads, a previous study reported that the smooth hammerhead occurred in that same area (Casper, *et al.*, 2005). There is also evidence that this fleet appears to be increasingly targeting sharks, including the smooth hammerhead (Casper, *et al.*, 2005). These fishing pressures have turned regular sightings of the species from the early 1900's to "functional" extinction in 2008 (*see* Casper, *et al.*, 2005; Ferretti, *et al.*, 2008 at 957, 960; Camhi, *et al.*, 2007 at 29). Camhi, *et al.*, 2007 estimates that hammerheads in the Mediterranean have declined by over 99% since the early 1900s (Camhi, *et al.*, 2007 at 29), and, in a different report, scientists determined that the smooth hammerhead has "virtually disappeared from the central-southern Mediterranean Sea since 1986" (Casper, *et al.*, 2005).

Bycatch observations also indicate that the pelagic fishery operating off the coast of northwest Africa kills an average of over 1,000 bycaught hammerhead sharks each year during the time that they aggregate in the warm, continental shelf waters in Mauritania's exclusive economic zone (June to December), and likely significantly more as the studies do not cover all of the months that the hammerheads (as well as their prey and the trawlers that target them) aggregate there (*see* Zeeberg, *et al.*, 2006 at 190, 191 (1083 estimated hammerhead bycatch mortalities between July and October 2002, 1003 estimated hammerhead bycatch mortalities between September and October 2003, 1078 estimated hammerhead bycatch mortalities between July and November 2004)). In fact, estimates of bycatch mortality reached 877 in a single month in September of 2003 (*see* Zeeberg, *et al.*, 2006 at 190). Between 2001 and 2005, 42% of the retained pelagic megafauna bycatch from over 1400 freezer-trawl sets in this fishery consisted of hammerhead species (smooth, scalloped, and great hammerheads) (NMFS, 2013 at 98 (citing Zeeberg, *et al.*, 2006)). Therefore, not only is the smooth hammerhead being bycaught in large numbers in this region, but it is being heavily retained. Additionally, in the sub-regional fisheries commission region that includes this Mauritanian fishery, "fishing occurs year-round, including during shark breeding season, and, as such, both pregnant and juvenile shark species may be fished, with shark fins from fetuses included on balance sheets at landing areas" (NMFS, 2013 at 66 (citation omitted)). Such practices are unsustainable and are sure to drive population declines. However, fishermen continue to land the species along the Northeast Atlantic coast (*see* Figure 12, *infra*; Buencuerpo, *et al.*, 1998 at 669).

Total number of fish sampled from 175 landings at the Algeciras (Cádiz) fish market and percentage by species from July 1991 to July 1992.

Species	Number	Percentage
Isurus oxyrinchus	5947	11.6
Prionace glauca	32,661	63.7
Alopias vulpinus	52	0.1
Alopias superciliosus	557	1.1
Sphyrna zygaena	757	1.4
Other sharks	224	0.4
Total sharks	40,198	78.5
Xiphias gladius	9990	19.5
Other bony fish	1017	2.0
Total	51,205	100.0

Figure 12. 757 smooth hammerheads were landed in this one year at a single fish market on the Northeast Atlantic coast just north of the Strait of Gibraltar (*see* Buencuerpo, *et al.*, 1998 at 669).

In addition to bycatch, the smooth hammerhead has been caught in directed shark fisheries off the coast of Spain, the West Coast of Africa, and possibly in other directed shark fisheries in this region (though it has not been reported separately from other hammerhead species in other locations) (Casper, *et al.*, 2005). Illegal, unreported, and unregulated fisheries account for significant portions of the catch in this area and fisheries statistics therefore will highly underestimate shark catch here (NMFS, 2013 at 67-68).

2. Northwest Atlantic

In the Northwest Atlantic, the smooth hammerhead's range extends from Nova Scotia to Florida and into the Caribbean Islands (Compagno, 1984 at 554; Bester, Undated).

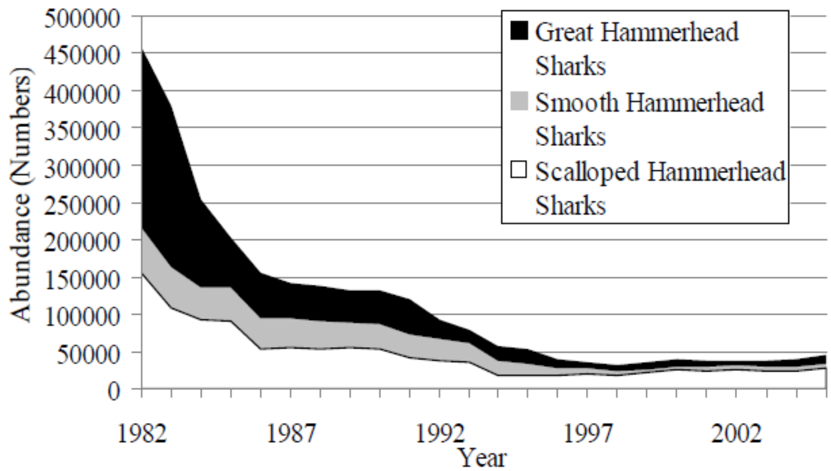


Figure 13. Population abundance estimates of the great, smooth, and scalloped hammerheads in the Northwest Atlantic and Gulf of Mexico (Hayes, 2007 at 112).

a. Commercial Fishing

Hammerheads are subject to extensive longline fishing pressure in the Northwest Atlantic, which has led to various estimated declines in abundance. One study looking at U.S. pelagic longline logbook data from the Northwest and Western Central Atlantic indicates that the hammerhead complex there (composed of smooth, scalloped, and great hammerheads) declined in abundance by 89% between 1986 and 2000 (*see* Camhi, *et al.*, 2007 at 29; Baum, *et al.*, 2003 at 389-90). Another study focusing on just the Northwest Atlantic estimated a 76% decline in *Sphyrna* spp. between 1992 and 2005 (Baum & Blanchard, 2010 at 229, 236). However, the species-specific information for the smooth hammerhead in U.S. waters indicates even more dire declines. While Hayes, 2007 noted a 90% decline for *Sphyrna* spp. from 1981-2005 in the U.S. Atlantic and Gulf of Mexico, the study noted a slightly higher 91% decline in smooth hammerheads specifically over the same time period in those waters (Hayes, 2007 at ii, 65). These population decreases are so severe that, in 2005, the entire smooth hammerhead population was at a mere 24% of the necessary size to provide a maximum sustainable yield of the species (Hayes, 2007 at 54). Additionally, it is worth noting that none of the decline estimates in these studies assess population levels in comparison to any data before 1981 or after 2005 although the species assuredly suffered significant population declines prior to 1981, as fishing pressure was extensive, and has likely continued to decline since 2005 as fishing pressure has continued unabated (*see* Hayes, 2007 (1981-2005); Camhi, *et al.*, 2007 (1986-2000); Baum, *et al.*, 2003 (1986-2003); Baum & Blanchard, 2010 (1992-2005)).

Hammerheads are caught incidentally and retained in the United States Atlantic commercial fishery (Abercrombie, *et al.*, 2005 at 786). However, in addition to bycatch, the smooth hammerhead has been caught in directed shark fisheries off the East Coast of the United States, and possibly in other directed shark fisheries in this region (though it has not been reported separately from other hammerhead species in other locations) (Casper, *et al.*, 2005). While fisheries statistics offer some insights into overutilization of the species, the fact that Mexican, and other, boats undertake illegal, unreported, and unregulated fishing in this area should also be taken into account because fisheries statistics alone will underestimate shark catch here (NMFS, 2013 at 68). Therefore, both directed and incidental commercial fishing in the Northwest Atlantic is adversely affecting the species.

b. Recreational Fishing

The United States also has one of the largest recreational shark fisheries in the world, with Florida having one of the largest recreational shark fisheries in the United States (Shiffman & Hammerschlag, 2014 at 396). Florida's international recreational fishing sector reported 842,756 charter boat trips in Florida in 2012 with a study from that year finding "that for charter boats based on the Atlantic coast of Florida, between 43.3% and 60% of trips targeted sharks, though often in addition to other species." (Shiffman & Hammerschlag, 2014 at 396, 403 (citation omitted)). This study located 137 charter boats in Florida alone that specifically advertised fishing excursions to catch sharks on their websites (Shiffman & Hammerschlag, 2014 at 398). This study also likely vastly underestimates the number of charter boats engaged in this practice as it only included charter boats that had websites (likely not all charter boats as they are typically small businesses), that the researchers located on a single search engine (almost certainly less than all charter boats as a result of search optimization), that specifically mentioned catching sharks (almost certainly less than all because shark capture happens incidentally as well), and because there are over 3,500 charter boat businesses registered in Florida, all of which could potentially target or bycatch sharks (Shiffman & Hammerschlag, 2014 at 397, 402-03). Both the charter boats' websites and the polling results indicating client desires and excitement from this study reflect a preference for catching hammerheads (Shiffman & Hammerschlag, 2014 at 400, 402). As a result of this interest, charter boats caught a reported 33,733 hammerheads in Florida in 2012 alone (Shiffman & Hammerschlag, 2014 at 401; *see also* Bester, Undated ("The smooth hammerhead is taken in the shark fisheries of south Florida and the West Indies . . .")).

While reported recreational hammerhead species catch data shows that nearly all hammerheads were released alive, only 68% of all sharks, regardless of species, caught in Florida were released alive (Shiffman & Hammerschlag, 2014 at 399). However, in addition to possible unreported hammerhead retentions or "release" of dead sharks (i.e. abandonment at sea), the species also suffers extremely high post-release mortality (*see* Shiffman & Hammerschlag, 2014 at 406; Gallagher, *et al.*, 2012 at 13; Camhi, *et al.*, 2007 at 28-29; Cortés, *et al.*, 2010 at 32). This means that the species typically dies when caught, even if released alive. For example, one study found that post-release mortality in the Northwest Atlantic is estimated to be 91.4% and 93.8% for the closely-related scalloped and great hammerheads, respectively (Camhi, *et al.*, 2007 at 28-29). Based on Florida's catch numbers, this would translate to between 30,832 and 31,735 mortalities at a minimum, even if there were no unreported captures or retentions. Cortés, *et al.*, 2010 assessed smooth hammerhead post-capture mortality for the Atlantic pelagic longline fishery, and found that the species had an 85% post-capture mortality with this type of gear (Cortés, *et al.*, 2010 at 32). Therefore, even assuming that Cortés, *et al.*, 2010's data represents a closer fit to smooth hammerhead post-capture mortality in the Northwest Atlantic recreational fishery, and that there were no unreported captures or retentions, this still represents 28,758 smooth hammerhead mortalities from recreational fishing in 2012 alone. This level of mortality is unsustainable.

c. Recovery Probability with Ongoing Commercial and Recreational Fishing

The above information shows that the smooth hammerhead is subject to extensive commercial and recreational fishing pressure in this region. This fishing pressure has reduced the population well below the level required to support a fishery that impacts the species and/or to provide for a maximum sustained yield for smooth hammerheads. The following figures show the likelihood of recovery to a level where smooth hammerheads are no longer considered overfished under a variety of scenarios and timescales.[13]

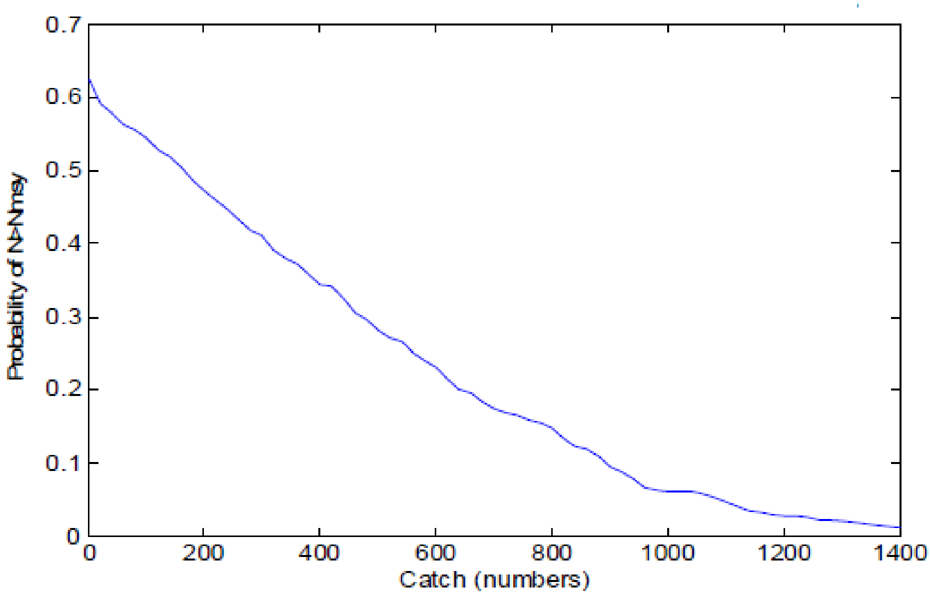


Figure 14. Probability (with 0.1 equaling 10% and 0.7 equaling 70%) of the number of smooth hammerhead individuals in the Northwest Atlantic and Gulf of Mexico outnumbering the number of smooth hammerhead individuals required to provide for a maximum sustained yield of the species in this region (an indication that the species is not overfished) in 30 years depending on the level of catch (Hayes, 2007 at 85).

[13] It is unclear whether this data adequately accounts for the smooth hammerhead's high post-release mortality level. Therefore, this data may overestimate the likelihood of recovery at the various timescales included by failing to include a large source of smooth hammerhead mortalities.

Time horizon	No Catch	C_{2005}	200% of C_{2005}	300% of C_{2005}
10 Years	11	6	3	1
20 Years	42	30	19	10
30 Years	64	47	29	17

Figure 15. Probability (percent) of smooth hammerhead shark population recovery to the point where it is no longer considered overfished over 10, 20, and 30 years in the Northwest Atlantic and Gulf of Mexico under a no catch regime and with equal, double, and triple catch levels as compared to catch from 2005 ("C_{2005}") (Hayes, 2007 at 78).

These figures indicate that recovering this population would be difficult and would take a significant amount of time even if catch were to completely cease and would become increasingly unlikely as catch remains the same or even increases. They also show that killing even a relatively small number of individuals will preclude recovery. Finally, these figures define recovery as returning the population to a status where it is not considered overfished and not to the point at which it has regained its historical population numbers. Therefore, it is worth noting that the difficulty shown in recovering the population actually sets a fairly modest goal and still implies that the process of recovery will be long and will require deep reductions in catch. A more expansive definition of recovery would thus require even more conservative estimates of recovery potential over the various timescales.

Given this information and the observed declines that the species has already faced in this region, ongoing commercial and recreational fishing practices in this region are not sustainable and represent a threat to the smooth hammerhead.

3. Southwest Atlantic

In the Southwest Atlantic, the smooth hammerhead's range extends from southern Brazil to southern Argentina (Compagno, 1984 at 554; Bester, Undated). Smooth hammerheads in the Southwest Atlantic face two main threats. The first is catches of juveniles and pups along the continental shelf by a variety of bottom gillnets and trawlers (Casper, *et al.*, 2005). The second is adult and juvenile catches by gillnets and longlines throughout the continental shelf and oceanic environments (Casper, *et al.*, 2005). Catch "[s]amples of hammerhead sharks[, including the smooth hammerhead,] taken between 1995 and 2008 from the operating longline and gill net vessels in the ports of Itajaí and Ubatuba ([ports occurring in municipalities in the] south and southeast of Brazil) indicated that . . . [, at least u]ntil 2008, vessels with drift nets normally caught hammerheads between 70 and 370 [centimeters total length (2.3-12.1 feet) (mode 180 centimeters (5.9 feet))]." (E-CoP16-Prop-43 at 9-10). This taking of both adults and juveniles of the same population is of particular conservation concern (Camhi, *et al.*, 2007 at 29) as it means that the smooth hammerhead faces intensive fishing pressure during all parts of its life cycle (Casper, *et al.*, 2005). Removing newborns, juveniles, and adults in this manner is unsustainable (E-CoP16-Prop-43 at 10).

In Brazil from 1983 to 2005, the abundance of neonates of smooth hammerheads varied from 1-5% of the abundance of neonates of scalloped hammerheads in the same area (Casper, *et al.*, 2005). Although the longline tuna fishery based in Santos City, São Paulo State, Brazil mainly targets tuna, these longliners began targeting sharks in 1983 with sharks comprising approximately 60% of the total longline catch by 1993 (NMFS, 2013 at 43). The total hammerhead yield in this fishery, which includes both scalloped and smooth hammerheads, increased from 7 tons in 1972 to 79 tons in 1988 and then more significantly to a maximum of 290 tons in 1990 (NMFS, 2013 at 43). A follow-up study conducted from 2007 to 2008 found that São Paulo State longliners were still targeting sharks and that the catch was dominated by shark species (49.2%) (NMFS, 2013 at 43). "By weight, hammerheads represented only 6.3% of the total shark catch, or 37.7 t[ons], a decrease from the previously reported yield. . ." (NMFS, 2013 at 43).

Furthermore, in the Southwest Atlantic, the smooth hammerhead is also caught as bycatch by the Taiwanese, Japanese, and other international longline fishing fleet with juveniles and adults taken as bycatch by longline fleets operating in shelf and oceanic waters off Uruguay and Brazil (Casper, *et al.*, 2005). The shark is additionally targeted in the eastern equatorial Atlantic Ocean by the swordfish fishery (Coelho, *et al.*, 2011 at 351). Illegal, unreported, and unregulated fisheries account for significant portions of the catch in this area and fisheries statistics therefore will highly underestimate shark catch here (NMFS, 2013 at 69).

"Given the declining trends apparent in other areas of the species' range where it is heavily fished, for example the Mediterranean Sea, the population in the Southwest Atlantic may be unable to withstand continued fishing pressure." (Casper, *et al.*, 2005). This inability to withstand fishing pressure is already playing itself out in the observed fisheries statistics for this region with observed declines in CPUE of over 80% of the hammerhead sharks complex during the period of 1995 to 2005 (E-CoP16-Prop-43 at 9 (citation omitted)) and with the Rio Grande do Sul area in Brazil appearing to have also experienced a nearly 2/3 decline in CPUE from 2000 to 2002 alone (E-CoP16-Prop-43 at 10 (citation omitted)). In addition, though the State of Santa Catarina, south of Brazil, landed 570 tons of hammerheads in 1994, its hammerhead catch plummeted to 44 tons in 2008, indicating drastic declines (E-CoP16-Prop-43 at 9 (citation omitted)). These declines in catch likely reflect population decline and not a reduction in effort as fishing in this region tends to be increasing in intensity. Therefore, while some uncertainty as to the exact rate of smooth hammerhead decline exists, based on the available data, both catch and CPUE have been declining in the Southwest Atlantic as a result of fishing pressure.

4. Eastern Pacific

In the Eastern Pacific, the smooth hammerhead's range extends from Northern California through the Gulf of California and down to the State of Nayarit in Mexico and also includes Panama, Columbia, the Galapagos Islands, and Ecuador through to southern Chile (Compagno, 1984 at 554; IUCN, Undated). Smooth hammerheads in this region suffer from both targeted catch and retained bycatch in artisanal and industrial fisheries (Casper, *et al.*, 2005). The Guatemalan, Costa Rican, Panamanian, and Mexican fisheries reported that 1% of the total chondrichthyan landings are smooth hammerheads (Casper, *et al.*, 2005). However, this percentage is still noteworthy as the smooth hammerhead's range is small in this area, indicating that this 1% is likely a representation of high catch volumes in limited areas (*see* Figure 4, *supra*). A smooth hammerhead study from south of the Tres Marias Islands, an island chain off the west coast of the Mexican State of Nayarit, reported that the smooth hammerhead was the most common out of 10 species of sharks caught in the fishery and composed of 35% of the recorded shark catches at one stage (Casper, *et al.*, 2005). However, the artisanal fishing fleet targeting smooth hammerheads in this area has not been able to catch smooth hammerheads since the late 1990s despite continued fishing, indicating a severe decrease in the smooth hammerhead population or even possible local extirpation (Casper, *et al.*, 2005).

In Ecuador, the smooth hammerhead represents 11% of the total chondrichthyan landings, with a high percentage consisting of juveniles (Casper, *et al.*, 2005). Additionally, 91% of those juveniles were females (Casper, *et al.*, 2005). There is also evidence indicating that hammerheads are caught and finned illegally in fisheries operating around the Galapagos Islands (Camhi, *et al.*, 2007 at 29). "Illegal fishing in this area is not only practiced by fishermen from the Galapagos, but also by the industrial and artisanal fleets from continental Ecuador and international fleets." (Casper, *et al.*, 2005). Fins from these illegal fisheries are then smuggled out through Columbia and Peru (E-Cop16-Prop-43 at 20-21). "Divers and dive guides in the Galapagos have noted a severe decrease in shark number and schools of hammerhead sharks." (Casper, *et al.*, 2005 (citation omitted)).

"Hammerhead sharks, including *S. zygaena*, are also caught by international purse seine fleets targeting tunas in the high seas of the Eastern Pacific, particularly those associated with Fish Aggregating Devices (FADs)." (Casper, *et al.*, 2005). The smooth hammerhead appears to likely constitute at least 1.7% of the shark catch from these activities (Casper, *et al.*, 2005). Illegal, unreported, and unregulated fisheries account for significant portions of the catch in this area and fisheries statistics therefore will highly underestimate shark catch here (NMFS, 2013 at 69).

Finally, the smooth hammerhead has also been caught in directed shark fisheries off the West Coast of the United States, and possibly in other directed shark fisheries in this region (though it has not been reported separately from other hammerhead species in other locations) (Casper, *et al.*, 2005). This data is all indicative of unsustainable fishing practices driving population declines in the Eastern Pacific.

5. Indo-West Pacific

In the Indian Ocean, the smooth hammerhead's range is constrained to southern India, Sri Lanka, the West and Southwest coasts of Australia, and the South African coast continuing up into southern Mozambique in the Indian Ocean[14] (Compagno, 1984 at 554; Bester, Undated; Casper, *et al.*, 2005). In the Western Pacific, the species' range extends from Viet Nam to southern Japan and southern Siberia and also includes the East and Southeast coasts of Australia and the entire New Zealand coastline (Compagno, 1984 at 554; Bester, Undated; Casper, *et al.*, 2005). The smooth hammerhead is caught in both artisanal and commercial fisheries as directed catch and as retained incidental bycatch (Casper, *et al.*, 2005). However, the fisheries data for this area groups different species of hammerheads together and illegal fishing and unreported catch is widespread here, thus skewing fisheries statistics (Casper, *et al.*, 2005; NMFS, 2013 at 66-67). That being said, extensive exploitation of the smooth hammerhead in this region is certainly occurring. The Spanish swordfish longline fishery, which targets sharks, is active in the Indian Ocean (Casper, *et al.*, 2005). Additionally, finning and discarding of shark carcasses has also been reported in the Indian Ocean, and a recent review of fisheries in the Indian Ocean reported that sharks are fully to over-exploited there (Casper, *et al.*, 2005). This finning includes increasing targeting of hammerheads for their fins

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[14] This South African coastline portion of the population includes a small area in the Southeast Atlantic, which represents the only occurrence of the species in the Southeast Atlantic (*see* Bester, Undated; Casper, *et al.*, 2005)

with at least 120 vessels illegally targeting hammerhead species (Camhi, *et al.*, 2007 at 29). In addition, the smooth hammerhead has been caught in directed shark fisheries around Taiwan, south-western Australia, and the Philippines, and possibly in other directed shark fisheries in this region (though it has not been reported separately from other hammerhead species in other locations) (Casper, *et al.*, 2005). While at least some bycaught individuals in this region are released, the post-capture mortality rate of 85-93.8% discussed *supra* means that many more deaths actually occur (*see* Gallagher, *et al.*, 2012 at 13; Camhi, *et al.*, 2007 at 28-29 (91.4% and 93.8% post-release mortality for scalloped and great hammerheads, respectively); Cortés, *et al.*, 2010 at 32 (85% post-release mortality observed for smooth hammerhead)).

The smooth hammerhead is bycaught in the demersal (close to the floor of the sea) gillnet fishery off the western coast of Australia (Casper, *et al.*, 2005). In New Zealand, neonates and small juvenile smooth hammerheads are commonly caught as bycatch in commercial gillnet fisheries for flatfish (Casper, *et al.*, 2005). These commercially bycaught sharks are often discarded, but they are usually already dead at that stage (Casper, *et al.*, 2005). In addition to the commercial overexploitation that the smooth hammerhead shark faces in Australia and New Zealand, it also faces overexploitation for recreational purposes. For instance, smooth hammerheads are bycaught and discarded by gamefishers targeting marlin in this area (Casper, *et al.*, 2005). Furthermore, in addition to bycatch that is the result of fisheries pressure, the smooth hammerhead is also caught in nets that are set to protect beaches from sharks (*see* III. G. 5. Indo-West Pacific, *supra*).

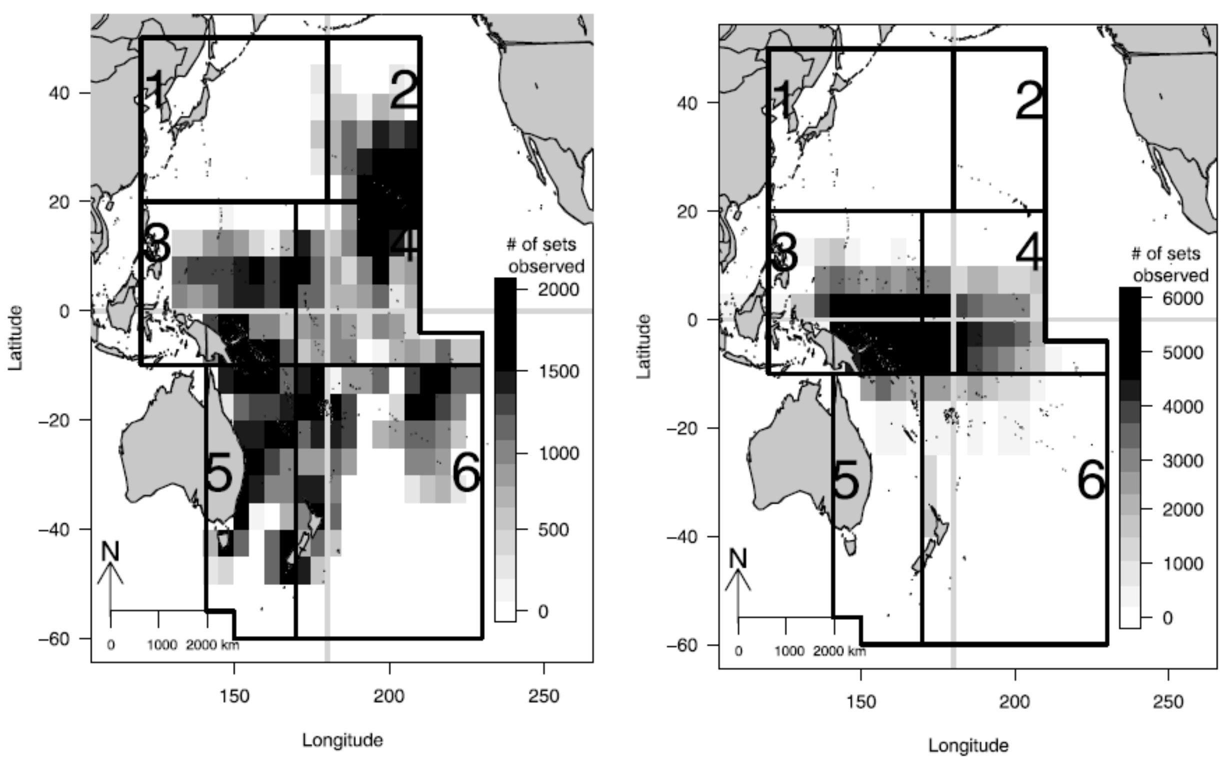

Figure 16. Number and location on longline (left) and purse seine (right) sets monitored in the WCPFC from 1995-2010 (Clarke, *et al.*, 2012 at 200). Note that observer coverage was only <1% in this longline fishery from 2005-2008 and was only 13-16% in this purse seine fishery from 2005 to 2009, with observer coverage likely comparable in other years, so these observer records are a fraction of actual sets that occurred in this region over the relevant time periods (*see* Clarke, *et al.*,

2012 at 199). The numbers in these polygons are the regions referenced in Figure 18, *infra*, and were taken from the WCPFC bigeye tuna assessment.

All of the smooth hammerhead's Western Pacific range occurs within waters regulated by the WCPFC (*see* Figure 16, *supra*). However, observer data for the tuna longline and purse seine fisheries operating in the WCPFC's waters are scarce and are often focused on oceanic areas outside of the smooth hammerhead's habitat (*see* Figure 16, *supra*).

Most of the observer data that does exist is from exclusive economic zones ("EEZs"), where observers are a condition of fishing licenses for foreign-flagged vessels, and, as a result, there is little or no information for "the shark catches of major fleets belonging to China, Taiwan, Japan, and Korea when they fish in their own EEZs or on the high seas." (Clarke, *et al.*, 2012 at 199). This means that Region 1, represented as the top left polygon in both maps in Figure 16, *supra*, contains essentially no observer data for either purse seine or longline shark bycatch as it covers the Taiwanese, Japanese, Korean, and northern Chinese coastlines (*see* Figure 16, *supra*). However, since finning and retention is extremely common in the WCPFC's area (*see* Figure 17, *infra*; Figure 18, *infra*) and since shark fins, and smooth hammerhead shark fins in particular, are highly valued in this region (*see, e.g.* E-CoP16-Prop-43 at 18 (noting that the smooth hammerhead's fins sold for $88/kg in the Hong Kong market in 2003, with prices likely increasing since then) (citation omitted); Yue Hing December, 2014 – 2 (showing that smooth hammerhead fins sell for up to $156 per kilogram as of December 2014 if they are of high quality); Clarke, *et al.*, 2006a at 202 (explaining that the Hong Kong shark fin market represents at least 50% of the global shark fin trade) (citations omitted)), exploitation of the species is likely at least as high as in other areas regulated by the WCPFC.

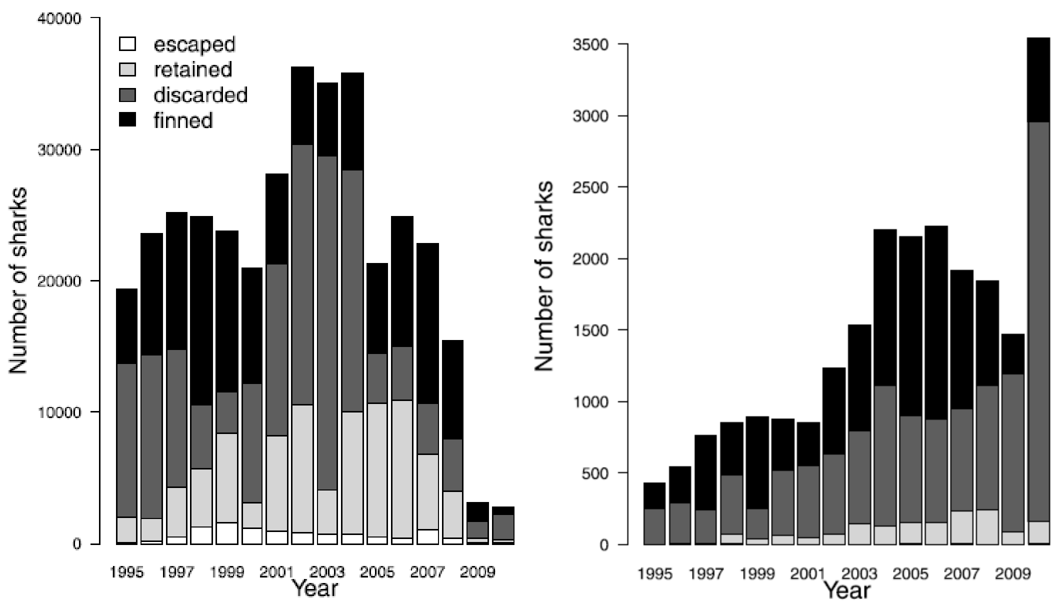

Figure 17. Fate of sharks caught in the WCPFC longlines (left) and WCPFC purse seine sets (right) from 1995-2010 as reported by observers (Clarke, *et al.*, 2012 at 205). Note that observer coverage was only <1% in this longline fishery from 2005-2008 and was only 13-16% in this purse seine fishery from 2005-2009, with observer coverage likely comparable in other years, so these numbers do not represent the actual numbers of sharks finned and retained, but are likely indicative of trends (*see* Clarke, *et al.*, 2012 at 199). Also, note that the much larger number of sharks observed in 2010 in

the purse seine data results from the new requirement for 100% observer coverage (Clarke, *et al.*, 2012 at 206).

The only WCPFC regions that both include smooth hammerhead habitat and have adequate observer data to infer exploitation are Regions 5, the bottom left polygon in both maps in Figure 16, *supra*, which is mostly composed of eastern Australia, part of New Zealand's South Island, and some small island nations, and 6, the bottom right polygon in both maps in Figure 16, *supra*, which includes the remainder of New Zealand and some small island nations, where good data exists for the longline fleet. The available data indicates that both finning and retention are rampant in Regions 5 and 6 with between 45% and 70% of sharks finned in these two Regions from 1998-2008 (Clarke, *et al.*, 2012 at 206). Although this observer data only covers sharks generally, it is evidence of extensive exploitation of sharks in the smooth hammerhead's habitat, which is likely impacting the species there to a significant degree.

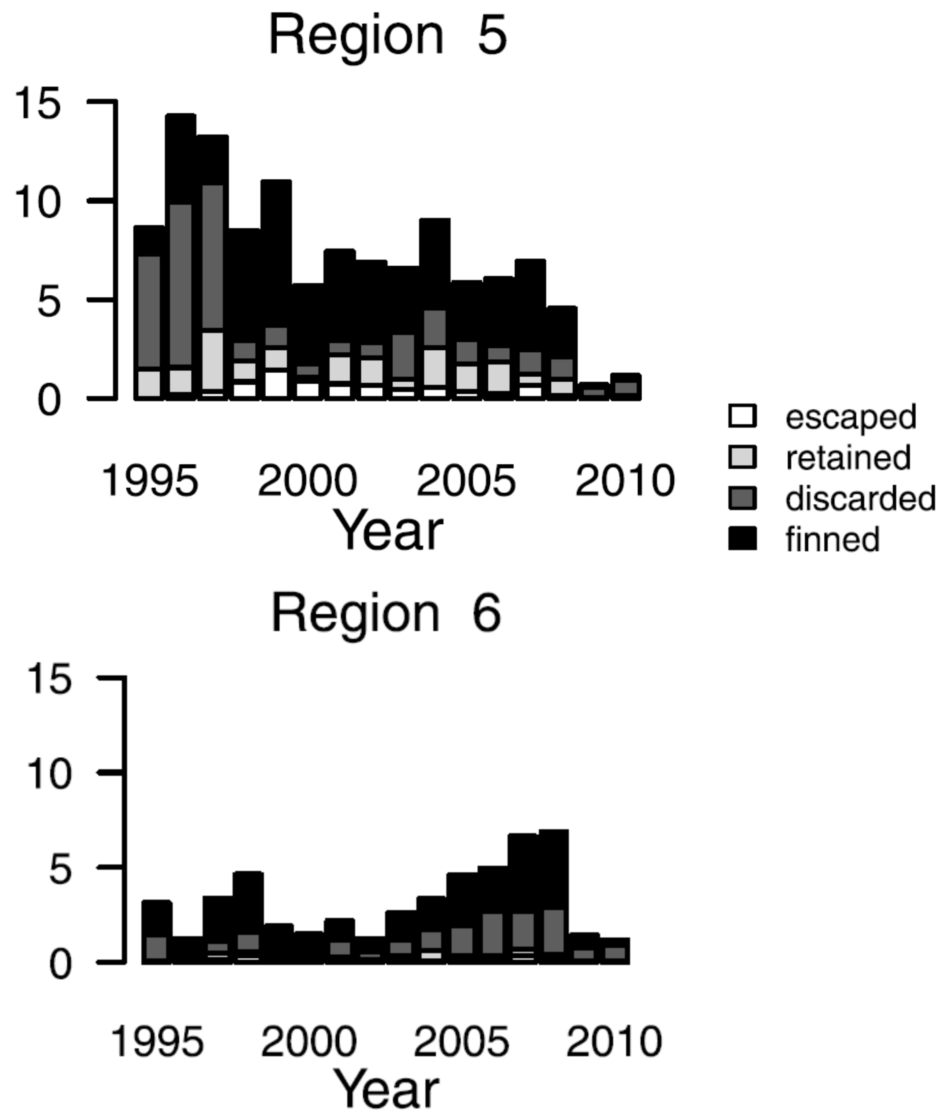

Figure 18. Number and fate of sharks (in thousands) caught in WCPFC Regions 5 and 6 from the longline fleet based on available observer data (Clarke, *et al.*, 2012 at 205).

Juveniles smooth hammerheads inhabit coastal nursery grounds in the South African portion of this region in large numbers. Consequently, large numbers of small smooth hammerheads are caught in gillnets set up to protect beaches in this area (*see* Diemer, *et al.*, 2011 at 236). One study documented a 64% decline in individuals of the closely related scalloped hammerhead species in these nets deployed off the beaches of Kwa-Zulu Natal, South Africa from 1978-2003, indicating a likely similar decline in smooth hammerheads in the area (*see* E-CoP16-Prop-43 at 11 (citation omitted)). Newborn smooth hammerheads are also likely caught, with resultant high post-capture mortality rates, by prawn fishery vessels off the South African coast (*see* Diemer, *et al.*, 2011 at 236). These juvenile fatalities have led to observed hammerhead declines in the closely related scalloped hammerhead, indicating likely similar smooth hammerhead declines as well. For example, prawn trawlers operating on the Tugela Bank in South Africa caught 3,288 newborn scalloped hammerheads in 1989, but this number plummeted to only 1,742 newborn scalloped hammerheads in 1992, a decline of over 47% in just three years (E-CoP16-Prop-43 at 11 (citation omitted); *see also* Diemer, *et al.*, 2011 at 229 (identifying a decline in newborn scalloped hammerheads in this area, which also likely indicates a decline in smooth hammerhead newborns as they are subjected to similar pressures)).

In addition to these incidental catches, the smooth hammerhead is also caught in targeted and recreational fisheries off the South African coast, which has contributed to the species' decline there (*see* Diemer, *et al.*, 2011 at 229). For example, "[a] study of directed shark fisheries at two sites in southwest Madagascar[, which reflects targeting of this population,] during 2001-2002 showed that hammerhead sharks represented 29% of sharks caught and 24% of the total wet weight, but species specific data are not available because fishermen do not differentiate between *S. lewini* and *S. zygaena*." (E-CoP15-Prop-15 at 10 (citation omitted)). This amalgamated catch data, while not including trend information, shows significant targeting of the species in these waters. However, in addition to showing significant smooth hammerhead targeting, competitive shore-based angling events targeting sharks off the South African coast did document a considerable decline in amalgamated hammerhead catches between 1977 and 2000 (*see* Diemer, *et al.*, 2011 at 230 (citation omitted)). And, in addition to these legal catches, illegally operating longlining vessels in this area also take individuals (*see* Diemer, *et al.*, 2011 at 229). Overall, the available data "suggests that the numbers of *S. zygaena* off the east coast of South Africa decreased [from 1984-2009]." (Diemer, *et al.*, 2011 at 236).

In addition to an overall population decrease, "[t]he vast majority of sharks tagged [in this area] were <150 cm [precaudal length ("PCL")] and were therefore neonate, juvenile, and/or subadult animals." (Diemer, *et al.*, 2011 at 235 (citing Compagno, 1984)). In fact, the most common size classes caught were between 80-120 cm PCL, which translates to 113-159 cm total length (PCL = 75.5% of total length (Diemer, *et al.*, 2011 at 230)), and the number of smooth hammerheads exceeding 160 cm PCL, which translates to 212 cm total length, is miniscule (*see* Diemer, *et al.*, 2011 at 232). In fact only 0.9% of the smooth hammerheads surveyed off the South African coast over this 25 year period exceeded 150 cm PCL, which translates to 199 cm total length (Diemer, *et al.*, 2011 at 233). Since smooth hammerhead males mature at 210-250 centimeters total length and females mature at 270 centimeters total length (Bester, Undated), there appear to be nearly no sexually reproductive smooth hammerheads left in this area. This indicates that the species is being fish and removed from South African coastal areas before it has the chance to breed, an unsustainable practice (*see, e.g.,* Figure 19, *infra*; Diemer, *et al.*, 2011 at 232-33).

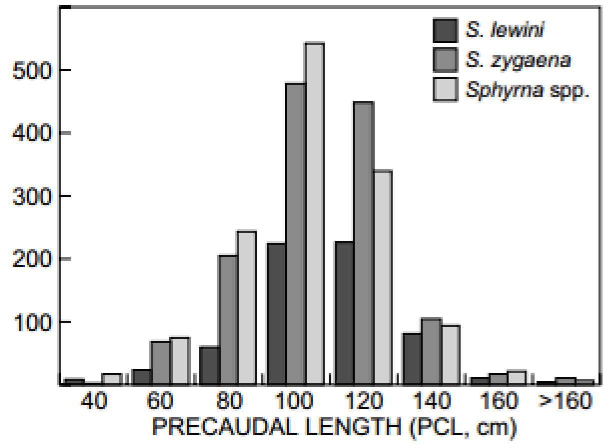

Figure 19. Precaudal length in centimeters of all hammerhead sharks tagged on the South African coast between 1984 and 2009 (Diemer, *et al.*, 2011 at 232).

These facts show multiple sources of overutilization in the Indo-West Pacific that threaten the smooth hammerhead, and the population trends section for this region, III. G. 5. Indo-West Pacific, *supra*, shows that this exploitation is causing the species to decline.

C. Disease or Predation[15]

High levels of arsenic have been reported in smooth hammerhead sharks (Storelli, *et al.*, 2003 at 1036-37). This may be due either to the sharks' diet or to a high capacity of the species to retain arsenic (Storelli, *et al.*, 2003 at 1037). Scientists have noted that this arsenic presence deserves particular attention because "it has recently been shown that, among organoarsenic compounds, dimethylarsinic acid has carcinogenic potential." (Storelli, *et al.*, 2003 at 1037 (citations omitted)). Therefore, smooth hammerheads are at an increased risk of cancer due to the high levels of arsenic in their systems.

D. The Inadequacy of Existing Regulatory Mechanisms

Although there are several international, regional, and national regulations relevant to the smooth hammerhead, these regulations do not adequately protect the species from overutilization and have furthermore proven to be insufficient by failing to prevent the species' ongoing decline. For instance, these regulations typically do nothing to address the non-overutilization threats that the species faces from disease and other natural and manmade causes. Also, because the ranges for the scalloped and smooth hammerhead sharks are very similar, NMFS' conclusion that the similar regulations for the scalloped hammerhead are inadequate for at least four populations of that species necessitates the same conclusion for at least the coordinate populations of smooth hammerheads (*see, e.g.,* Figure 24, *infra* (showing range overlap); 79 Fed. Reg. at 38,219 ("We agree that . . . inadequate regulatory measures . . . are threats to the Central & SW Atlantic DPS, Eastern Pacific DPS, Eastern Atlantic DPS, and Indo-West Pacific DPS [of scalloped hammerheads . . ."]). Since

[15]NMFS should also consider the pollutant-based impacts discussed in IV. A. The present or threatened destruction, modification, or curtailment of its habitat or range, *supra*, under this ESA listing criterion to the extent that these pollutants cause or exacerbate smooth hammerhead disease or predation. *See* 16 U.S.C. § 1533(a)(1).

these populations would represent a "significant portion" of the smooth hammerhead's range under a reasonable interpretation of that term, the species should be listed as threatened or endangered throughout its range. *See* 16 U.S.C. §§ 1532(6), (20) (definitions for endangered and threatened species that provide for listing species as a whole where they are endangered or threatened "throughout all or a significant portion of their range . . ."; Figure 24, *infra*). Furthermore, note that, because the smooth hammerhead faces 85-93.8% post-capture mortality rates even where it is released, to be effective regulations must not only prevent retention of the species but must also prevent capture in the first instance as even released smooth hammerheads will almost always die (*see* Gallagher, *et al.*, 2012 at 13; Camhi, *et al.*, 2007 at 28-29 (91.4% and 93.8% post-release mortality for scalloped and great hammerheads, respectively); Cortés, *et al.*, 2010 at 32 (85% post-release mortality observed for smooth hammerhead)). Most, if not all, regulations that currently exist focus on limiting retention and do not prevent capture in the first instance. These regulations are therefore inadequate.

1. Shark Finning Bans

At least 21 countries, the European Union, and nine Regional Fisheries Management Organizations ("RFMOs"), including the International Commission for the Conservation of Atlantic Tuna in 2004, the Indian Ocean Tuna Commission and the Inter-American Tropical Tuna Commission in 2005, the Commission for the Conservation of Southern Bluefin Tuna in 2008, and the WCPFC in 2010, have implemented shark finning bans (E-Cop16-Prop-43 at 20; Dulvy, *et al.*, 2008 at 474). However, the strict enforcement that is necessary for these measures to be effective is often lacking, thus hampering the efficacy of these bans (Dulvy, *et al.*, 2008 at 474). For example, "[c]ases of illegal fishing and shark finning that still occur in these places, such as Malpelo,[Columbia,] indicate the need for measures to prevent countries from importing fins that were obtained illegally." (E-Cop16-Prop-43 at 20). Also, where RFMOs or international or regional agreements are concerned, implementation of the bans is often not mandatory or enforceable, leading to continued finning even where a ban is in place. For example, "[a]s of October 2010, of the 32 WCPFC members only half had confirmed they were fully implementing the finning prohibition. Only 11 provided specific confirmation of [any ban implementation], and few of these reported the degree of compliance." (Clarke, *et al.*, 2012 at 206). As a result, "although some reduction in the proportion of sharks finned appears to have occurred in the [WCPFC] purse-seine fishery, there is little evidence that the proportion of sharks finned in the longline fishery has been reduced since the WCPFC measure was adopted." (Clarke, *et al.*, 2012 at 206).

Most countries and RFMOs use fin-to-carcass weight ratios as a means to ensure compliance with finning bans, which are difficult, costly to enforce, and vary between fleets (Dulvy, *et al.*, 2008 at 474; E-Cop16-Prop-43 at 20; Clarke, *et al*, 2012 at 198 (assessing the weaknesses in one such RFMO fin ratio)). In addition to these difficulties, the upper end of the ratio creates loopholes that "potentially enable fishermen to fin sharks without exceeding the ratio limit." (Dulvy, *et al.*, 2008 at 474). Though this particular loophole has been closed in the United States with the passage of the Shark Conservation Act of 2010 and the abolishment of the fin-to-carcass ratio in favor of a policy of requiring that sharks are landed with their fins attached, statements from NOAA's Office of Law Enforcement are useful in showing the difficulty that fin-to-carcass ratios pose to enforcement personnel in the many jurisdictions where they still exist. Citing Special Agent Paul Raymond of NOAA's Office of Law Enforcement, Abercrombie, *et al*, 2005 noted that, "[a]lthough shark finning . . . is illegal in US waters, it is suspected that some fishermen may be finning incidentally caught hammerheads and keeping just their fins for their high value, while retaining carcasses from different shark species with higher value flesh but lower value fins. . ." (Abercrombie, *et al.*, 2005 at 786 (citing personal comments from Special Agent Paul Raymond of NOAA's Office of Law enforcement)). By retaining high value carcasses for meat from other sharks and high value fins from hammerheads, fishermen are able to continue finning while maximizing profits and avoiding fin bans. Therefore, even where these finning bans exist, there are often opportunities to avoid their regulation and/or to harvest smooth hammerhead sharks in unsustainable numbers to satisfy market demands.

Additionally, finning bans only "prohibit the retention of shark fins on board vessels without the corresponding carcasses" and do not prohibit landing the entire shark and finning it once it is on land (Dulvy, *et al.*, 2008 at 474, 475). As a result, even where perfectly enforced, they cannot halt overfishing of sharks that happens where the carcasses are landed before being finned (Dulvy, *et al.*, 2008 at 474). There is still an incentive to take these species through directed fishing efforts and through bycatch retention in order to satisfy the market demand for their resultant products. Furthermore, while retention-based weaknesses of finning bans are important to note, even where bycaught individuals are released and not finned or otherwise retained, the smooth hammerhead suffers from an 85-93.8% post-release mortality rate (*see* Camhi, *et al.*, 2007 at 28-29 (91.4% and 93.8% post-release mortality for scalloped and great hammerheads, respectively); Cortés, *et al.*, 2010 at 32 (85% post-release mortality observed for smooth hammerhead)). As a result, even where a captured smooth hammerhead is released alive, it will typically die. Therefore, initial capture, and not only retention, must also be avoided. Finally, these bans only help to avoid overutilization threats and do nothing to address the other threats that the smooth hammerhead faces. While Defenders applauds finning bans, encourages their continuing proliferation, and believes that they do reduce market demand for shark fins, they primarily address issues of cruelty and waste and are not a sufficient mechanism on their own to protect shark species facing exceptionally serious threats, like the smooth hammerhead (*see* Dulvy, *et al.*, 2008 at 474).

2. Other National, Regional, and Local Measures

Defenders strongly supports national and regional measures for the conservation of sharks, and is in fact petitioning for one in the present case by requesting that NMFS list the smooth hammerhead under the ESA. However, none of the measures that are currently in place are adequate to protect the smooth hammerhead and displace the need for ESA protections. "French Polynesia (2006), Palau (2003, 2009), Maldives (2010), Honduras (2011), The Bahamas (2011), Tokelau (2011), and the Marshall Islands (2011) have all enacted legislation prohibiting shark fisheries throughout their Exclusive Economic Zones. Other countries have protected areas where no shark fishing is allowed, such as Cocos Island (Costa Rica), Malpelo Sanctuary (Colombia), and the marine reserve of Galapagos Islands (Ecuador)." (E-Cop16-Prop-43 at 20). While these are commendable starts, they can only offer protection in these limited areas and will suffer enforcement related issues as long as a market for smooth hammerhead products exists. For instance, cases of illegal fishing and shark finning in the Malpelo Sanctuary indicate the need for measures to prevent countries, including the United States, from importing fins that were obtained illegally (E-Cop16-Prop-43 at 20). In addition, such bans do not stop incidental capture of the species, which is typically fatal for the smooth hammerhead (*see*, *e.g.,* Cortés, *et al.*, 2010 at 32). By listing the smooth hammerhead under the ESA, the United States can help protect the species in its waters; prevent importation of the species into, and exportation of the species out of, the country; and take other actions, such as recovery planning, that will provide a conservation benefit to the species. The existing national and regional regulatory protections currently in place for the species, some of which are discussed below, do not suitably replace these benefits.

a. Mexico

"In Mexico, the utilization of this species is regulated by the General Law for Sustainable Fisheries and Aquaculture and the National Fisheries Chart." (E-Cop16-Prop-43 at 21 (citations omitted)). Mexico also appears to have implemented a partial ban on vessels that can engage in targeted gillnetting for hammerheads and some temporal restrictions on targeted fishing (E-Cop16-Prop-43 at 22-23). While the current efficacy and enforcement of these measures is unclear, Mexico contains little smooth hammerhead habitat (apparently only some coastal area in the vicinity of Baja California) (*see* Bester, Undated). In addition, Mexico appears to be the source of significant illegal shark fishing pressure at present, which makes its ability to enforce these protections effectively less likely (*see* NMFS, 2013 at 68; 78 Fed. Reg. at 20,738). Therefore, to the extent that these measures are successful at curbing smooth hammerhead declines, this success will affect only small numbers of smooth hammerheads, and the extent to which they are currently, or will be, effective is unclear.

b. Brazil

In 1998 Brazil passed a law that banned finning in its waters (E-Cop16-Prop-43 at 19). However, Brazil seems to have abandoned this prohibition based on enforcement difficulties (E-Cop16-Prop-43 at 19; *see also* IV. D. 1. Shark Finning Bans, *supra* (for information on why shark finning bans are inadequate)). In 2004, Brazil included the smooth hammerhead in a list of species that are endangered by extinction and over-exploited in Brazil (E-Cop16-Prop-43 at 19). However, this list offers much less protection than the ESA as it merely sets a minimum smooth hammerhead catch size of 60 centimeters (E-Cop16-Prop-43 at 19). Because the species matures at between 210 and 270 centimeters (depending on sex) and is in fact born at 50 centimeters, nearly the allowed catch size already at birth, the basis for this seemingly arbitrary, and much too small, size requirement is unclear (*see* Bester, Undated). This protection is likely nominal only as it still allows removal of both juveniles and adults in unsustainable numbers and because Brazil, as can be seen with the finning ban, likely will have issues enforcing it. Finally, Brazil has limited pelagic gillnets and prohibited trawling at a distance of less than 1.5 to 3 nautical miles from shore (E-Cop16-Prop-43 at 19). "However, compliance with these laws has proven to be very difficult. Thus, trawl and gillnet activities in [smooth hammerhead] nursery areas continue." (E-Cop16-Prop-43 at 19). Therefore, though we commend the Brazilian government's continuing efforts to address the overexploitation of the smooth hammerhead, the protections that are currently in place are inadequate to do so.

c. Ecuador

"In an effort to help stop the illegal finning occurring in the Galapagos, the Ecuadorian Government issued a decree in 2004 prohibiting fin export from Ecuador. Unfortunately, the Decree resulted in establishing illegal trade routes, with fins now being exported mainly via Peru and Colombia where there is no finning ban in place." (E-Cop16-Prop-43 at 20-21). Ecuador also released executive decrees and conservation policies in 2007 and 2008 aimed at protecting sharks from overexploitation (E-Cop16-Prop-43 at 21). However, the efficacy and enforceability of these later localized protections is thus far unclear and, even if effective, would only protect a small portion of the species' range.

d. Columbia

Columbia has a general finning ban and two areas where directed shark fishing is banned (E-Cop16-Prop-43 at 20). However, neither of these practices address the issue of bycatch or of directed shark fishing outside of the two protected areas, and neither offer any species-specific protection that is tailored to protecting the smooth hammerhead. The smooth hammerhead may also be being "prioritized" for conservation in Columbia, though this does not appear to have provided the species with any concrete protections at this stage (E-Cop16-Prop-43 at 20). In addition, any protections in Columbia are likely to be met with enforcement difficulties as the country is already serving as an illegal trade route for illegal Ecuadorian shark fins and is experiencing illegal fishing and shark finning even in its protected areas (E-Cop16-Prop-43 at 20-21).

e. U.S. Highly Migratory Species Fishery Management Plan

The smooth hammerhead is included in the Large Coastal Shark ("LCS") management unit on the U.S. Highly Migratory Species Fishery Management Plan ("HMS FMP") (Casper, *et al.*, 2005). This includes ten other sharks within the LCS management unit (Hayes, 2007 at 16). However, "there are no management measures specific to this species and no stock assessments have been undertaken for it." (Hayes, 2007 at 16; *see also* E-Cop16-Prop-43 at 20 (the smooth hammerhead and other species in this complex "are assessed at the complex level. The overfished and overfishing status of this complex is unknown.")). NMFS has thus far not released any species-specific protections for the smooth hammerhead like those that exist for the scalloped hammerhead (E-Cop16-Prop-43 at 20). Therefore, this inclusion in the LCS is offering minimal, if any, protection to the smooth hammerhead.

In its proposed listing rule for the scalloped hammerhead, NMFS considered conservation efforts being made to protect the scalloped hammerhead in its assessment of the species' endangerment. 78 Fed. Reg. 20,718, 20,745-47 (April 5, 2013). As part of this process, NMFS considered Amendment 5 to the HMS FMP. 78 Fed. Reg. at 20,745-46. It found that

> the Amendment 5 to the Consolidated HMS FMP is a conservation effort with high certainty of implementation and is highly likely to be sufficiently effective to substantially reduce the overutilization of the [Northwest Atlantic and Gulf of Mexico] scalloped hammerhead shark DPS. Overutilization of this DPS by commercial and recreational fisheries was identified as a primary threat presenting a moderate risk of extinction to the DPS currently, but was expected to decrease in risk severity in the foreseeable future. We anticipate that the foregoing conservation measures will benefit the status of the species in the foreseeable future, thereby further decreasing its extinction risk from the threat of overutilization identified by the [ecological risk assessment] team.

78 Fed. Reg. at 20,746; *see also* 79 Fed. Reg. at 38,218 (discussing Amendment 5, its consideration in the proposed rule, and its implementation after the proposed rule in the final rule as support for not listing the Northwest Atlantic and Gulf of Mexico DPS of scalloped hammerheads). However,

Amendment 5 to the HMS FMP does not cover smooth hammerheads and therefore does not represent a protective effort for the petitioned species. *See* 79 Fed. Reg. at 38,218 (Amendment 5a addressed scalloped hammerhead, sandbar, blacknose, and Gulf of Mexico blacktip sharks and Amendment 5b addressed dusky sharks). As a result, there is no comparable protective mechanism "with high certainty of implementation and [that] is highly likely to be sufficiently effective to substantially reduce the overutilization" of the Northwest Atlantic population of smooth hammerheads. *See* 78 Fed. Reg. at 20,746. The only applicable protection from Amendment 5 is the part of amendment 5a that creates a minimum size catch for recreational fishermen catching large hammerheads, which would include smooth hammerheads. *See* 79 Fed. Reg. at 38,218. However, this minimum size is set at 6.5 feet (198 cm), which is still well below the size at maturity of either male (7 to 8 feet (210 to 250 cm)) or female smooth hammerheads (8.7 feet (270 cm)) and would thus allow continued catch of reproductively immature smooth hammerheads. 79 Fed. Reg. at 38,218; Bester, Undated. This minimum size was thus apparently not created with protection of smooth hammerheads in mind and sets an arbitrary catch limit as to the species. Additionally, it continues the authorization for recreational fishermen to retain smooth hammerheads and does not address commercial exploitation at all. Therefore, NMFS should consider the differing levels of protection afforded to smooth versus scalloped hammerheads by Amendment 5 in determining the smooth hammerhead's level of endangerment in this region, despite the conclusions that NMFS reached about the scalloped hammerheads in this region.

f. South African Marine Protected Areas

> [T]he region between the Lupatana River and the Mkozi River (a distance of approximately 9 [kilometers] and known as Waterfall Bluff) was proclaimed a no-take zone for shore-angling within the Pondoland Marine Protected Area (MPA) in June 2004. Furthermore, the area between the Sikombe River and Mboyti River (~40 [kilometers]) and seaward to the [1,000 meter] depth contour (~10 [kilometers]) is an offshore no-take zone (i.e. no fishing off a vessel) within the Pondoland MPA.

(Diemer, *et al.*, 2011 at 237 (internal citation omitted)). However, 63.9% of the smooth hammerheads tagged in a 1984-2009 study covering this region were tagged at Port St Johns, an area outside of these protected areas (Diemer, *et al.*, 2011 at 237). Therefore, while these conservation measures may provide some protection to juvenile and adolescent hammerheads in these protected areas, they will be insufficient to protect the majority of smooth hammerheads, which appear to occur outside of their boundaries, or those individuals who stray beyond the protected areas' boundaries even though they are generally located therein. In addition, the efficacy of enforcement efforts in these protected areas is unclear, which could drastically undercut their conservation success.

g. Florida's Ban on Landing Smooth Hammerheads

The Florida Fish and Wildlife Conservation Commission ("FWC") includes the smooth hammerhead on a list of shark species for which all harvest, possession, landing, purchase, sale, or exchange is prohibited, both for whole sharks and their constituent parts (Florida Fish and Wildlife Conservation Commission, Undated). The FWC explains that anglers may catch and release these species in state waters and may take them in federal waters, barring federal protection, and land them in Florida so long as the boats do not stop in state waters before landing (Florida Fish and

Wildlife Conservation Commission, Undated). While Defenders commends Florida for recognizing the smooth hammerhead's endangerment and taking steps to protect the species in its waters, this protection is inadequate. First, this protection only applies to fish captured in Florida's state waters, which only extend out to 3 nautical miles in the Atlantic (Florida Fish and Wildlife Conservation Commission, Undated - 2). Therefore, smooth hammerheads outside of this narrow strip of a single state's coastline are not protected, as evidenced by the ability to land the species in Florida if it is caught outside the state's waters. Secondly, catch and release of smooth hammerheads is still allowed. This is problematic because the species faces extremely high post-release mortality rates (*see* Gallagher, *et al.*, 2012 at 13; Camhi, *et al.*, 2007 at 28-29 (91.4% and 93.8% post-release mortality for scalloped and great hammerheads, respectively); Cortés, *et al.*, 2010 at 32 (85% post-release mortality observed for smooth hammerhead)). Therefore, merely stopping retention of the species is likely insufficient to halt the species' decline, especially where charter boat operators and clients appear to target hammerheads specifically and in extremely high numbers (*see* Shiffman & Hammerschlag, 2014 at 400, 402; IV. B. 2. b. Recreational Fishing, *supra*). Finally, illegal Mexican shark fishing appears to be ongoing in and around Florida's waters, which will hamper the efficacy of this protection (*see* NMFS, 2013 at 68; 78 Fed. Reg. at 20,738).

h. State Shark Fin Trade Bans

In addition to the U.S. federal shark finning ban, nine U.S. states and three U.S. Pacific territories have implemented additional shark fin bans, with proposed legislation pending in several other states (Shark Stewards, Undated). These laws differ from the U.S. federal ban in that they do not ban the landing of shark fins, as that is regulated by the Federal Magnuson-Stevens Fishery conservation and Management Act, 16 U.S.C. §§ 1801-84, they instead ban possession, sale, offer for sale, trade, or distribution of shark fins in most circumstances (*see* Shark Stewards, Undated). However, while these laws are necessary to protect sharks, they are not sufficient to do so. The reason that these laws are inadequate is that they only affect intrastate trade in shark fins. They do not target the other drivers of smooth hammerhead endangerment, including bycatch, and do not affect intrastate or interstate commerce in states that have not enacted such bans. Therefore, while these state bans are an excellent step forward, they only offer piecemeal, incidental, and uncertain protection to the smooth hammerhead and are therefore inadequate to protect the species.

3. International Regulation

a. United Nations Convention on the Law of the Sea

The smooth hammerhead is listed on Annex I, Highly Migratory Species, of the United Nations Convention on the Law of the Sea ("UNCLOS") (Camhi, *et al.*, 2007 at 28). This means that the sharks should be subject to its provisions concerning fisheries management in international waters (Camhi, *et al.*, 2007 at 28). However, "no international catch limits have been adopted and few countries regulate hammerhead shark fishing." (Camhi, *et al.*, 2007 at 28). Furthermore, even if management were in place, the United States has not signed this treaty.[16] Therefore, the species does not receive any tangible protection under the UNCLOS.

[16] *See* http://www.un.org/depts/los/reference_files/chronological_lists_of_ratifications.htm.

b. Convention on the Conservation of Migratory Species of Wild Animals

The smooth hammerhead is not included in the appendices of the CMS. Therefore, the species does not receive any protection under those provisions.

c. Convention on International Trade in Endangered Species

In March 2013, at the 2013 CITES Conference of the Parties Meeting in Bangkok, Thailand, the CITES Parties agreed to increase protections for five commercially exploited shark species, including the smooth hammerhead, by listing them under Appendix II (CITES, 2013).[17] However, the Appendix II listing offers insufficient protection to the smooth hammerhead as it simply requires that exporting countries demonstrate that the exported smooth hammerhead carcasses, fins, etc. came from sustainably harvested populations (*see* Norman, 2005). This is problematic because there is currently no clear standard for these so-called "non-detriment findings," which are used to determine whether killings of covered species would threaten sustainable populations (CITES, Undated – 1). Even if there were some way to determine what a sustainable population means it would be difficult to demonstrate a sustainable smooth hammerhead population because of the amalgamated catch records for the species and its confusion with other hammerheads (*see generally* VIII. SIMILARITY OF APPEARANCE LISTING, *infra*).

In addition, there is relatively little that can be done to enforce CITES' requirements, particularly when there is an illegal market for smooth hammerheads. Part of the problem is that Appendix II only requires a permit for exports of species listed therein. Therefore, it does not require a country to demonstrate that domestically-consumed smooth hammerheads came from sustainable populations (*see* CITES, Undated – 2). Furthermore, the fact that only an export permit, and not an import permit, is required for international trade means there is one less level of scrutiny that those wishing to smuggle smooth hammerhead products internationally must meet (*see* CITES, Undated – 2). Thus, fishermen from one country could kill smooth hammerheads in international waters and take them directly to any importing country. If they were to do so without returning to their country of origin they would completely avoid any permitting procedure under Appendix II of CITES. In addition to the issue of non-party countries, several countries entered reservations to the smooth hammerhead's protection, including Canada, Guyana, Japan, and Yemen, and will therefore be exempt from even the limited requirements contained therein (CITES, 2014).

Even if the smooth hammerhead were listed under a more restrictive Appendix I listing, CITES does not represent an adequate replacement for ESA listing. NMFS acknowledged the insufficient effect of Appendix I listings in its determination for the listing of the largetooth sawfish under the ESA, when it stated that illegal foreign trade of the species continued "in spite of the CITES listing and national laws, due to lack of enforcement." 76 Fed. Reg. 40,822, 40,832 (July 12, 2011); NOAA, Undated at 3.

[17] The United States supported this proposal and had in fact proposed to list the species itself in 2010 (USFWS, 2013; E-CoP15-Prop-15 at 1-2).

Finally, since CITES only focuses on trade threats, it offers insufficient protection from the other, non-trade threats that the smooth hammerhead faces including both recreational fishing and bycatch..

4. RFMO Regulation

"In general . . . international fisheries managers continue to view sharks as bycatch rather than target species requiring management, despite the fact that the high value of shark fins is widely acknowledged as a major driver of shark mortality." (Clarke, *et al.*, 2012 at 198 (citations omitted)). This has meant that RFMO's have provided little protection for shark species and that these protections have generally been inadequate where they do exist. This is the case for the smooth hammerhead as well.

a. Western Pacific Fisheries Commission ("WCPFC")

The WCPFC has listed the smooth hammerhead (as part of a group of hammerhead sharks) as a "key shark species" (New Zealand Ministry of Fisheries, 2013). But this designation alone does not restrict fishing or otherwise protect the species from threats. In addition, the "total shark catch in the WCPFC area is highly uncertain due to non- and underreporting of sharks in vessel logbooks . . ." making quantification of an allowable catch difficult (Clarke, *et al.*, 2012 at 198). In fact, "[p]rior to February 2011 the WCPFC did not require members to submit catch data for sharks. Thus, many members reported no shark catches or reported them only in an undifferentiated shark category." (Clarke, *et al.*, 2012 at 199).

b. International Commission for the Conservation of Atlantic Tuna ("ICCAT") Recommendations

ICCAT recommends not retaining, transshipping, landing, storing, or selling hammerhead sharks in the family *Sphyrnidae*, except for bonnethead sharks (*Sphyrna tiburo*), taken in the Convention area in association with ICCAT fisheries. The recommendation cites sustainability concerns for scalloped and smooth hammerhead sharks, difficulty in identifying the three species (scalloped, smooth, and great hammerheads) without bringing them onboard, and issues with ICCAT Contracting Parties' obligations to report Task I (catch statistics) and Task II (catch and effort statistics) data as reasons for adopting the recommendation (ICCAT Recommendation 10-08). However, while this recommendation is meant to be binding, ICCAT has had problems in the past with enforcing compliance with its recommendations (*see generally, e.g.,* Raymakers & Lynham, 1999). Additionally, it is only of regional applicability and would not stop exploitation occurring elsewhere. Third, it only prohibits retention and will not address post-capture mortality of released bycatch. Fourth, it only addresses catch and not any of the other threats that the species faces. Finally, "developing coastal states" are exempt from this recommendation (E-Cop16-Prop-43 at 21). Therefore, this recommendation faces a number of shortcomings that render it inadequate to protect the smooth hammerhead from the threats it faces.

As this section explains, none of the existing regulatory mechanisms are adequate to protect the smooth hammerhead from further declines as it moves toward extinction.

E. Other Natural or Manmade Factors Affecting its Continued Existence[18]

1. K-Selected

Smooth hammerheads have an increased susceptibility to extinction because they are a "K-selected" or "K-strategy" species (they are a large, long-lived species that reproduces infrequently, invest significant energy in the young they do produce, and experiences a long delay in reaching sexual maturity) (*see* Goble & Freyfogle, 2010 at 1058-60; III. F. Reproduction and Lifespan, *supra* (both male and female smooth hammerheads reach sexual maturity around age 9, live until around 18 or 20, and females have a gestation period of 10-11 months)).[19]

> K-strategy species are more extinction prone than are r-strategy species. The very efficiency with which K-strategy species exploit their environment is a liability *during periods of rapid or chaotic change*. The larger body size of individuals of a K-strategy species - while giving an advantage in interspecific competition and in defense against predators and allowing individuals to exploit a larger area - means that there are fewer individuals . . . At the same time, lower reproduction rates make it more difficult both for the species to recover if its population becomes depressed and for it to adapt to a changed environment because fewer offspring contain less genetic variability. Thus, the very "fittedness" of K-strategy species to a particular environment - which is advantageous during periods of stability - becomes a serious handicap when the habitat changes more rapidly than genes can be substituted in a population - and in species that reproduce slowly, genes are substituted slowly.

(Goble & Freyfogle, 2010 at 1059-60 (emphasis in original)).

Smooth hammerheads are currently experiencing the type of rapid, chaotic change that makes their K-selected life history pattern a liability. This is because smooth hammerheads are being fished and removed from their habitat and otherwise harmed at a rate greater than they can replenish their numbers (*see, e.g.,* IV. B. Overutilization for Commercial, Recreational, Scientific, or Educational Purposes, *supra*). As a result of these pressures, many of the smooth hammerhead's physical attributes and reproductive adaptations have gone from being beneficial to creating increased risk of species extinction. For instance, smooth hammerhead recruitment is hindered by the fact that they are large, long-lived, reach sexual maturation late in life, and reproduce infrequently (*see* Gallagher, *et*

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[18] NMFS should also consider the pollutant-based impacts discussed in IV. A. The present or threatened destruction, modification, or curtailment of its habitat or range, *supra*, under this ESA listing criterion to the extent that NMFS determines that those pollutants cause impacts in addition to habitat degradation. *See* 16 U.S.C. § 1533(a)(1).

[19] Note that "[a]lthough few data are available on *S. zygaena*'s life-history characteristics, it is a large hammerhead shark and presumably at least as biologically vulnerable as *S. lewini*," which NMFS felt required ESA listing based in part on its biological vulnerability (*see* Camhi, *et al.*, 2007 at 29; NMFS, 2013 at 70-72; 79 Fed. Reg. at 38,219). Also, the smooth hammerhead's high post-capture mortality rate, discussed in IV. B. Overutilization for Commercial, Recreational, Scientific or Educational Purposes, *supra*, should be considered under this threat criterion as well, consistent with the scalloped hammerhead's consideration by NMFS in NMFS, 2013 at 71, as it is another limiting life history factor affecting the species' continued existence.

al., 2014 at 3; III. F. Reproduction and Lifespan, *supra*). This type of life history pattern means that the species does not replenish itself as quickly as smaller, shorter-lived, r-selected species and is, therefore, more vulnerable when individuals are removed from the population or species reproduction is otherwise disrupted. Additionally, removal of individuals may be especially problematic because it may mean removing the small proportion that are reproductively viable and/or removal of individuals before they have a chance to propagate. This is what is happening to the smooth hammerhead as, in many fisheries where smooth hammerheads are targeted or incidentally bycaught, the majority of the catch is juveniles. Removing the individuals before they can reproduce means that there is a substantial risk that the population will rapidly collapse.

"Moreover, hammerheads have also evolved a derived form of viviparous embryonic nutrition, which includes the merging of a yolk sac with the uterus to form an early placenta-like organ that nourishes pups throughout their yearlong gestation." (Gallagher, *et al.*, 2014 at 3 (citation omitted); *see also* Bester, Undated). "With very few natural predators, these biological adaptations permit hammerheads to invest substantial resources in the long-term development of a relatively small number of offspring, similar to mammalian species. However, under the current conditions of overfishing, these ecological and developmental specializations make them disproportionately vulnerable to even low levels of harvest." (Gallagher, *et al.*, 2014 at 3 (citation omitted)). Therefore, this aspect of the smooth hammerhead's K-selected life history pattern is also contributing to its endangerment.

2. Aggregations

The prominence of juvenile smooth hammerhead catch is likely due in part to their tendency to gather in large aggregations of hundreds of individuals (E-CoP16-Prop-43 at 42; Abercrombie, *et al.*, 2005 at 776). Some of the popular pupping grounds include the north Gulf of California, the east Bay of Plenty, the Firth of Thames, and the Inner Hauraki Gulf, the shallow waters around New Zealand, and the shallow coastal waters off south Brazil and Uruguay (E-CoP16-Prop-43 at 42). However, aggregations are also common around Mauritania, South Africa, Brazil, and likely other areas (Zeeberg, *et al.*, 2006 at 190, 191; Diemer, *et al.*, 2011; Casper, *et al.*, 2005). These aggregations are susceptible to overfishing that unsustainably removes juveniles and ensures that these individuals are never able to reproduce. If the species' juveniles are removed before they can complete this vital life history stage then the species will inevitably face steep declines as the limited reproductive members of the species die out, or are caught and killed, and are not replaced.

3. Synergistic Effects

The synergistic effects of aforementioned threats could conspire to cause the extinction of smooth hammerheads. "Like interactions within species assemblages, synergies among stressors form self-reinforcing mechanisms that hasten the dynamics of extinction." (Brook, *et al.*, 2008 at 457 (internal citations omitted)).

The combination of threats to the smooth hammerhead and its habitat could cause a greater and faster reduction in the remaining population than might be expected from simply the additive impacts of the threats. "[H]abitat loss can cause some extinctions directly by removing all individuals over a short period of time, but it can also be indirectly responsible for lagged extinctions by facilitating invasions, improving hunter access, eliminating prey, altering biophysical conditions and increasing inbreeding depression. Together, these interacting and self-reinforcing systematic and stochastic processes play a dominant role in driving the dynamics of population trajectories as extinction is approached." (Brook, *et al.*, 2008 at 453 (internal citations omitted)).

The smooth hammerhead is already at risk as a low-fecundity or K-selected species, rendering it more vulnerable to synergistic impacts of multiple threats. "Traits such as ecological specialization and low population density act synergistically to elevate extinction risk above that expected from their additive contributions, because rarity itself imparts higher risk and specialization reduces the capacity of a species to adapt to habitat loss by shifting range or changing diet. Similarly, interactions between environmental factors and intrinsic characteristics make large-bodied, long-generation and low-fecundity species particularly predisposed to anthropogenic threats given their lower replacement rates." (Brook, *et al.*, 2008 at 455 (internal citations omitted)). Therefore, the synergistic impacts of multiple threats to the smooth hammerhead may increase the extinction pressure that it faces.

V. DISTINCT POPULATION SEGMENTS

Analysis of smooth hammerhead populations indicates that the Northeast Atlantic and Mediterranean Sea, Northwest Atlantic, Southwest Atlantic, Eastern Pacific, Indo-West Pacific populations qualify for protection as DPSs according to the ESA.

A. Discreteness

The populations of smooth hammerheads described above are distinct. Firstly, these populations are markedly separate from each other as a result of multiple types of barriers that separate the different populations. Secondly, these populations are delimited by international governmental boundaries within which differences in control of exploitation, management of habitat, conservation status, and regulatory mechanisms exist.

The barriers that separate these populations include the smooth hammerhead's required habitat. Smooth hammerheads prefer waters to depths of 20 meters, which tend to occur near coasts, estuaries, and coral reefs (Bester, Undated; Compagno, 1984 at 554). Though the species is occasionally found in waters to depths of 200 meters, smooth hammerhead sharks "avoid open-ocean and transoceanic movements" (Bester, Undated; Hayes, 2007 at 6). In addition to this shallow depth range preference, the smooth hammerhead also undertakes relatively short annual movements (Diemer, *et al.*, 2011 at 229 (finding that the maximum and average annual movements of scalloped hammerheads was 629 km and 147.8 km whereas these distances were only 384 km and 141.8 km respectively for smooth hammerheads)). Therefore, due to these constraints, smooth hammerheads do not cross into different ocean basins because the ocean areas between these populations are much too deep, contain the wrong habitat for the species, and are too far from other populations. These barriers isolate the populations in the Northeast Atlantic and Mediterranean Sea, Northwest Atlantic, Southwest Atlantic, Eastern Pacific, and Indo-West Pacific

Additionally, a smooth hammerhead study assessing the population in the Southeastern Atlantic and Indian Ocean waters surrounding the South African coast indicates that the maximum and average annual distance moved by the species are 384 km and 141.8 km with the highest speed estimated as a minimum rate of movement of 5.1 km per day (Diemer, *et al.*, 2011 at 233; E-CoP16-Prop-43 at

42). Therefore, it is unlikely that populations will connect or reconnect even if they are only separated by relatively short distances, especially if these separations are marked by water exceeding 20 meters in depth.

DNA studies show that females of the closely-related scalloped hammerhead species do not intermix across ocean basins and that intermixing by males is rare or absent depending on the region (NMFS, 2013 at 76-77). This is so even though the scalloped hammerhead routinely inhabits deeper waters than the smooth hammerhead and routinely travel greater distances (*see* NMFS, 2013 at 34 (stating the some scalloped hammerheads were observed at depths of up to 980 meters); Bester, Undated (indicating that smooth hammerheads typically only inhabit water 20 meters or less in depth, but occasionally travel in waters up to 200 meters deep); Compagno, 1984 at 554 (same); Diemer, *et al.*, 2011 at 233 (scalloped hammerheads travel greater distances)). In addition, though there is not extensive species-specific genetic differentiation information available, the information that does exist supports the proposition that the smooth hammerhead is genetically distinct amongst its populations. For example, Duncan, *et al.*, 2006 surveyed nine smooth hammerhead individuals from "widely separated localities" in the Atlantic, Pacific, and Indian Oceans and found significant differentiation between these samples (Duncan, *et al.*, 2006 at 2242, 2244 Fig. 2). These samples showed higher haplotype diversity for smooth hammerheads than for scalloped hammerheads, which researchers also described as having high haplotype diversity from different areas ($h = 0.80 \pm 0.020$ SD for scalloped hammerheads versus $h = 0.83 \pm 0.127$ SD for smooth hammerheads) (Duncan, *et al.*, 2006 at 2242). Additionally, the genetic information provided in Abercrombie, *et al.*, 2005, shows that genetic samples from Pacific and Atlantic Ocean smooth hammerhead specimens differ from each other in the observed amplicons, which provides further evidence of genetic differentiation of the species amongst these oceans (*see* Abercrombie, *et al.*, 2005 at 782; Figure 20, *infra*). This is further indication that genetic differentiation study between these smooth hammerhead populations would likely show significant differentiation in smooth hammerheads across basins that is at least as great, if not greater, than that observed in scalloped hammerheads.

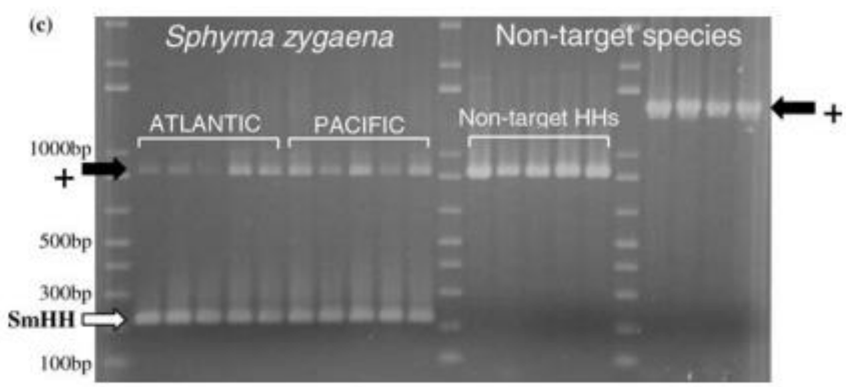

Figure 20. Amplification results obtained using the smooth hammerhead's species-specific primer in triplex PCR format against target and nontarget shark species. The open arrow indicates the smooth hammerhead's species-diagnostic amplicon and the solid arrow indicates the positive control amplicon (+) from target and non-target species (Abercrombie, *et al.*, 2005 at 782).

This genetic differentiation information is consistent with Ovenden, *et al.*, 2011 which found that, although the scalloped hammerhead mixed between Australia and Indonesia in the Indo-West Pacific, the milk shark (*Rhizoprionodon acutus*) likely did not (Ovenden, *et al.*, 2011 at 1507-08).

Ovenden, *et al.*, 2011 ascribed some of this difference to the milk shark's lesser vagility, freedom to move about, as compared to the scalloped hammerhead (Ovenden, *et al.*, 2011 at 1497). As discussed, *supra*, the smooth hammerhead also appears to be less vagile than the scalloped hammerhead (*see* Diemer, *et al.*, 2011 at 229 (finding that the maximum annual movement for scalloped hammerheads was 629 km, whereas it was only 384 km for smooth hammerheads)). In addition, both the milk shark and smooth hammerhead inhabit similar, shallower depth ranges (0-200 meters) as compared to the scalloped hammerhead (0-275 meters regularly with observations up to 980 meters), making deep ocean translocations less likely (*see* Carpenter, Undated (milk shark); Casper, *et al.*, 2005 (smooth hammerhead); Camhi, *et al.*, 2007 at 8 (scalloped hammerhead); NMFS, 2013 at 34 (scalloped hammerhead maximum)). Since the smooth hammerhead is less oceanic and vagile than the scalloped hammerhead, the smooth hammerhead is even less likely than the scalloped hammerhead, which NMFS recognized "rarely conducts trans-oceanic migrations" and was therefore subject to discrete populations for DPS purposes, to undertake trans-oceanic migrations. *See* 78 Fed. Reg. at 20,721.

Fossil records would also support genetic differentiation amongst populations as they show that hammerheads' common ancestor was similar to the smooth hammerhead (*see* Lim, *et al.*, 2010 at 577). This similarity indicates that the species has likely been differentiated and breeding within its isolated populations for a very long time relative to other hammerheads. Therefore, it has likely been increasing in genetic differentiation amongst populations, for perhaps longer than any other hammerhead species.

In addition to the marked separation of these populations, the smooth hammerhead's global range also extends across many international governmental boundaries and across waters regulated by many RFMOs (*see* Figure 21, *infra*; Figure 22, *infra*).

Figure 21. Map of RFMO waters, with each RFMO regulating individually and having differing, or no, regulatory protections for the smooth hammerhead (http://www.fao.org/fishery/topic/2940/en).

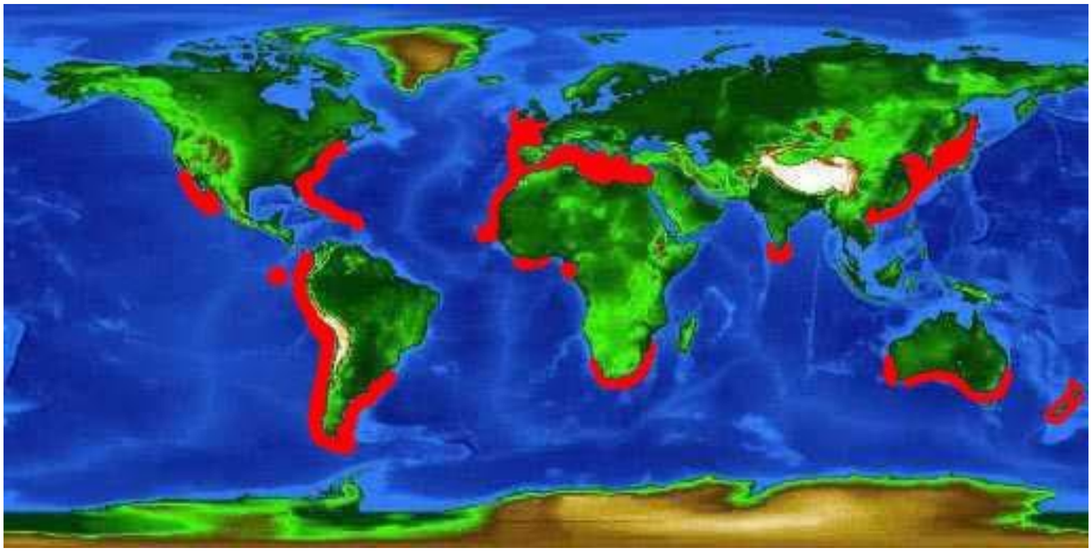

Figure 22. The smooth hammerhead populations are not bounded by national and regional boundaries and exhibit international range even within oceanic regions (*see* Bester Undated).

This broad range results in differences in control of exploitation, management of habitat, conservation status, and regulatory mechanisms. These differences are described in much more detail in IV. D. The Inadequacy of Existing Regulatory Mechanisms, *supra*, which is incorporated by reference here instead of restated. These differences are significant because the biggest threat to the species is overutilization for commercial purposes, which can continue unabated in the face of inadequate regulatory mechanisms. Since the various international, national, regional, and RFMO regulations relevant to the species exist throughout all of the aforementioned populations, and since exploitation in these populations varies, they all meet the discreteness requirement for this reason as well.

Due to the physical, ecological, historical, and behavioral factors that separate the different populations of the smooth hammerhead, and the resultant DNA differences amongst these populations, and the differences in management, regulation, and exploitation of the smooth hammerhead between countries, regions, and RFMOs, the populations of the smooth hammerhead should be considered sufficiently discrete for protection as DPSs under the ESA.

B. Significance

Each of the populations of smooth hammerheads is biologically and ecologically significant. Figure 22, *supra*, shows that the loss of the smooth hammerhead from any one of these identified populations would "result in a significant gap in the range of the taxon." *See* 61 Fed. Reg. at 4725. While the species has a widespread range, its populations within this range are actually fairly constrained. Therefore, it is unlikely that any of these populations would be recolonized if they were extirpated and extirpation from a fairly small area would remove all individuals from the Northwest Atlantic or Northeast Pacific for example. The smooth hammerhead's populations do not form the large, continuous blocks of habitat required to provide sufficient redundancy to overcome localized extirpations and elimination of each population would likely be permanent and would remove the species from a large area of their current habitat. *See* 79 Fed. Reg. at 38,226 (explaining that extirpations of the related scalloped hammerhead in any of its populations would likely result in permanent removal of those populations, even where the populations share a coastline, because migrations between these populations are rare and re-colonization would therefore be highly unlikely, especially when those migrations would have to occur across oceans). Each population discussed is a significant proportion of the smooth hammerhead's total population. Therefore, the loss of any one of the populations would result in a significant gap in the range of the smooth hammerhead.

Furthermore, as the discussion of an observed lack of intermixing between basins for scalloped hammerheads noted, genetic differentiation between smooth hammerheads from "widely separated localities," and evidence from the fossil record above indicates, the best available science shows that the smooth hammerhead is genetically differentiated amongst its basins (*see* V. A. Discreteness, *supra*). As a result of these factors, the populations discussed herein also satisfy the significance requirement for DPS listing.

Because all of the populations of the smooth hammerhead are sufficiently discrete and significant, these populations all qualify as DPSs under the ESA. Additionally, each DPS meets multiple ESA listing criteria, discussed *supra*. Consequently, each of the five DPSs warrants listing as "threatened" or "endangered" under the ESA. NMFS should additionally consider whether threats to the smooth hammerhead in one or more of these populations are such that the threats cover a "significant portion of its range," and, if so, then Defenders requests that NMFS list the species throughout its range in accordance with the ESA. *See* 16 U.S.C. §§ 1532(6), (20) (requiring only that the relevant species qualify for listing in all or a "significant portion of its range" to be listed worldwide).

VI. NEGATIVE FINDING ON SCALLOPED HAMMERHEAD NORTHWEST ATLANTIC AND GULF OF MEXICO DPS

NMFS determined that the Northwest Atlantic and Gulf of Mexico DPS of the closely-related scalloped hammerhead did not warrant listing based on a status review of threats to that species in the assessed DPS. *See* 79 Fed. Reg. 38,213. However, the smooth hammerhead's Northwest Atlantic population faces serious overutilization and other threats in the region and should still be listed throughout its range, or alternatively in DPSs including this Northwest Atlantic DPS. This is because the smooth hammerhead population discussed here is geographically distinct from that assessed for the scalloped hammerhead Northwest Atlantic and Gulf of Mexico DPS, and thereby does not face identical threats; the threats to the smooth hammerhead are more severe than those for the scalloped hammerhead DPS; and NMFS applying at least one basis for its negative scalloped hammerhead DPS finding in this case would be in contravention of *Pritzker*, the recent porbeagle shark case, at least at the 90-day finding stage.

Notably, since the scalloped hammerhead Northwest Atlantic and Gulf of Mexico DPS was largely delimited by U.S. waters and the smooth hammerhead population referenced in this petition is not, the smooth hammerhead population discussed in this petition is not geographically coextensive with the referenced scalloped hammerhead DPS. The smooth hammerhead population discussed in this petition in fact extends into Canada in the North and the Caribbean islands in the South (*compare* Compagno, 1984 at 554; Bester, Undated; *with* NMFS, 2013 at 83 (Northwest Atlantic and Gulf of Mexico scalloped hammerhead DPS extends only from New Jersey to Florida and throughout the Gulf of Mexico)). Since the regulatory mechanisms and threat assessments relevant to the scalloped hammerhead decision will not all apply to another species present in other waters, the findings for these two different populations will necessarily vary. Simply, the smooth hammerhead faces additional, or more extreme, threats and lesser protections both in the waters that overlap between these two populations and in the non-U.S. waters that the smooth hammerhead inhabits (*see generally* IV. IDENTIFIED THREATS TO THE PETITIONED SPECIES: CRITERIA FOR LISTING, *supra*). Therefore, although NMFS did not list the scalloped hammerhead DPS that partially geographically overlaps with this smooth hammerhead population, this in no way precludes listing the smooth hammerhead throughout its range, or alternatively in a DPS in this region, based in part on threats in the Northwest Atlantic.

The scalloped hammerhead status review looked at several categories of extinction risk for the species in the face of ongoing threats to the species in the various scalloped hammerhead DPSs. In the face of these threats, the status review characterized the scalloped hammerhead Northwest Atlantic and Gulf of Mexico DPS's extinction risk based on abundance as moderate then and low in the foreseeable future (defined as 50 years out) (NMFS, 2013 at 90). NMFS relied on a number of population statistics and forecasts for this scalloped hammerhead DPS in making its determination. NMFS cited over 80% declines of scalloped hammerheads in the DPS since 1981, 10 years of fairly stable populations from 1995-2005, a 91% chance of rebuilding population in 30 years based on 2005 catch levels, five consecutive years of catch levels below 2005 levels from 2006-2010, stronger management measures in these waters, and a proposed rebuilding plan for the scalloped hammerhead here (NMFS, 2013 at 90-91). These considerations do not apply to the Northwest Atlantic smooth hammerhead population. The relevant smooth hammerhead population experienced a *91% decline* from 1981-2005 (Hayes, 2007 at ii, 65), shows a mere *47% chance* of rebuilding its population here (defined as increase to the point at which it could support a maximum sustained yield) in 30 years based on 2005 catch levels (Hayes, 2007 at 78), and there is no available evidence of decreasing catch, a stable population trend, or improved management measures or rebuilding plans for the population (*see* IV. D. The Inadequacy of Existing Regulatory Mechanisms, *supra*; *see also, e.g.,* IV. D. 2. e. U.S. Highly Migratory Species Fishery Management Plan, *supra*). As a result of these differences, the smooth hammerhead is under greater extinction pressure in this region than the scalloped hammerhead Northwest Atlantic and Gulf of Mexico DPS was in its partially geographically overlapping range. These more intense threats are also in the context of a smooth hammerhead population that is already much less abundant here than the scalloped hammerhead Northwest Atlantic and Gulf of Mexico DPS, thereby indicating that the smooth hammerhead population can withstand fewer losses than the scalloped hammerhead DPS before its population crashes and it enters the extinction vortex (*see* Camhi, *et al.*, 2007 at 29; Baum, *et al.*, 2003 at 389-90 (catch here composed mostly of scalloped hammerheads); Baum & Blanchard, 2010 at 229, 236 (smooth hammerheads represented just 15 of the 850 identified hammerheads in the dataset for this region with scalloped hammerheads representing another 742)).

NMFS also assessed the scalloped hammerhead's growth rate and productivity as they relate to the species' extinction risk in the Northwest Atlantic and Gulf of Mexico DPS. One study indicates that the smooth hammerhead has a similar rate of increase to the scalloped hammerhead, which NMFS characterized as "suggesting general vulnerability to depletion." (NMFS, 2013 at 91; Cortés, *et al.*, 2010 at 32). However, this same study also indicates that the smooth hammerhead has a susceptibility to pelagic longline activities, which are common in the Northwest Atlantic, that is nearly 50% greater than the scalloped hammerhead's susceptibility to this same gear (Cortés, *et al.*, 2010 at 32; *compare* NMFS, 2013 at 91 (characterizing the scalloped hammerhead as having a moderate risk of extinction under these categories). This increased susceptibility to pelagic longlining lead the study to rank the smooth hammerhead as being more vulnerable to this type of gear than the scalloped hammerhead (Cortés, *et al.*, 2010 at 32). Therefore, where species-specific data exists as to threats to the smooth hammerhead in this region, the data shows that the smooth hammerhead is at a greater risk of extinction in the Northwest Atlantic than the unlisted scalloped hammerhead Northwest Atlantic and Gulf of Mexico DPS was in its partially overlapping range.

In addition to facing greater extinction risk in these waters, the scalloped hammerhead DPS finding is inapplicable as to the smooth hammerhead's extinction risk in this region for at least on other reason. Even if NMFS were to find that the smooth hammerhead's decline was only historical and that the species was potentially stable, or even potentially increasing slightly, now in this region, like it did for the Northwest Atlantic and Gulf of Mexico scalloped hammerhead DPS, such a determination would not be sufficient to deny the species ESA listing, at least at the 90-day finding stage after *Pritzker*. *See* 2014 WL 6946022 at *5-7. After *Pritzker*, such uncertainty as to extinction risk is to be resolved in a status review and subsequent 12-month finding. Therefore, the information presented as to the Northwest Atlantic population of smooth hammerheads is at least sufficient to require that NMFS make a positive 90-day finding as to this population, even if it fails to do so for the species as a whole.

VII. CRITICAL HABITAT

This Petition also requests that NMFS designate critical habitat in U.S. waters concurrently with final ESA listing. Critical habitat should protect the areas most important to the smooth hammerhead's survival, such as breeding grounds or coastal areas. These areas should include the species' habitat along the East Coast of the United States and into the Gulf of Mexico; its habitat in the waters in or near the Caribbean Sea, including in Puerto Rico and the U.S. Virgin Islands; its habitat off the coast of California in the Eastern Pacific; and anywhere else the species may occur in U.S. waters.

VIII. SIMILARITY OF APPEARANCE LISTING

Should NMFS determine that the threats to the smooth hammerhead are insufficient on their own to warrant listing the shark as an endangered or threatened species under the ESA (either worldwide or alternatively in any or all of the proposed DPSs), then NMFS should still list the smooth hammerhead based on its similarity of appearance to the scalloped hammerhead. Section 4 of the ESA, 16 U.S.C. § 1533(e), provides that NMFS may "treat any species as an endangered species or threatened species even though it is not listed pursuant to this section," when the following three conditions are satisfied:

1. 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;
2. The effect of this substantial difficulty is an additional threat to an endangered or threatened species; and
3. Such treatment of an unlisted species will substantially facilitate the enforcement and further the policy of this chapter.

16 U.S.C. §§ 1553(e)(A)–(C); *see also* 50 C.F.R. §§ 17.50–51.

NMFS recently issued a final rule listing two scalloped hammerhead DPSs as endangered and two scalloped hammerhead DPSs as threatened. 79 Fed. Reg. 38,213. Since the smooth hammerhead meets the ESA's similarity of appearance requirements with respect to the scalloped hammerhead, the smooth hammerhead should also be listed as "threatened" or "endangered" to protect scalloped hammerheads.[20]

NMFS also recently made a negative similarity of appearance finding for the great hammerhead (*Sphyrna mokarran*). 79 Fed. Reg. 33,509, 33,525 (June 11, 2014). In doing so, NMFS determined that the great hammerhead was sufficiently morphologically distinct from the scalloped hammerhead that enforcement personnel would not have difficulty in differentiating the species based on three primary considerations – overall size, head shape, and distinctive fins. 79 Fed. Reg. at 33,525. However, all three of these morphological characteristics are much more similar in the scalloped and smooth hammerheads, especially at the life history stage at which these species are exploited and in the dismembered state in which enforcement personnel observe the species during landings and during import and export. The morphological similarities between scalloped and smooth hammerhead sharks *would* make it difficult for enforcement personnel to differentiate the species at the relevant point in time, when inspections occur, such that it would result in an additional threat to the scalloped hammerhead and such that listing the smooth hammerhead would facilitate the enforcement of the scalloped hammerhead's protections. This similarity of appearance is especially important in the present case because the United States represents both an important market for shark fin products, with shark fin soup commanding high prices, and an important transshipment location for shark fins in trade. Therefore, providing effective enforcement of the scalloped hammerhead's protections by also protecting the smooth hammerhead and not allowing sale or transshipment of either species in the United States would provide strong conservation benefits to the listed scalloped hammerhead populations. As a result, should NMFS fail to list the smooth hammerhead in its own right, NMFS should alternatively list the species as an endangered, or alternatively as a threatened, species under the ESA as a result of its similarity of appearance to the listed scalloped hammerhead DPSs.

A. Close Resemblance

The smooth hammerhead so closely resembles the scalloped hammerhead at the point in question that "enforcement personnel would have substantial difficulty in attempting to differentiate between the listed and unlisted species." 16 U.S.C. § 1533(e)(A); 50 C.F.R. § 17.50. There are nine species of hammerhead sharks and "[s]pecies-specific population trends for hammerheads are rarely available because of the amalgamation of catch data and *confusion among species*." (Camhi, *et al.*, 2007 at 28, 29 (emphasis added)). In fact, smooth and scalloped hammerheads "are often confused and misidentified, *even at the genus level*." (Camhi, *et al.*, 2007 at 29 (emphasis added)). With this evident confusion between the smooth and scalloped hammerhead species and the difficulty identifying them, even to genus, ongoing legal catch of smooth hammerheads would threaten the scalloped hammerhead with increased risk of capture and subsequent retention because it would allow fishermen to profit from scalloped hammerheads by claiming that they were actually smooth hammerheads.

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[20] The ESA defines the term species to include "any distinct population segment of any species . . ." 16 U.S.C. § 1532(16). Therefore, the listed scalloped hammerhead DPSs are species sufficient to qualify other species for listing based on their similarity of appearance.

The Parties to the CITES convention recognized this trade threat due to similarity of appearance when they included the smooth and great hammerhead sharks under Appendix II of CITES based on Annex 2b, Criterion (A), the look-alike clause, because of their similarity of appearance to the scalloped hammerhead (E-CoP16-Prop-43 at 1). The United States formally recognized this similarity of appearance, and the consequent increased trade threat for the scalloped hammerhead that this similarity of appearance poses, by supporting the proposal to list the smooth, scalloped, and great hammerheads (*see* USFWS, 2013). In fact, the United States submitted a different CITES proposal seeking to list the smooth and great hammerheads under the CITES look-alike clause based on their similarity of appearance to the scalloped hammerhead three years earlier (E-CoP15-Prop-15 at 1-2 (stating that this was a joint proposal by the United States and Palau)).

The CITES standard for determining whether a species bears a close enough resemblance to a CITES-listed species to warrant being listed based on that similarity of appearance is actually much more rigorous than the ESA's similarity of appearance standard. CITES requires that listing of species based on similarity of appearance is "justified if the parts and derivatives of these species in trade resemble those of the listed Appendix II species (scalloped hammerhead in this case) *to the extent that enforcement officers would be unable to distinguish them*." (Food and Agriculture Organization, 2012 at 39 (emphasis added)). Under the ESA, the enforcement personnel need only have "substantial difficulty" differentiating between the species. *See* 16 U.S.C. § 1553(e)(A). By supporting the smooth hammerhead's CITES similarity of appearance listing, and indeed by drafting its own proposal to list the species as a scalloped hammerhead look-alike, the United States acknowledged that not only would enforcement personnel have "substantial difficulty" differentiating between the parts and derivatives of the species, but that they would in fact be "unable" to do so (*see* USFWS, 2013; E-CoP15-Prop-15). The ESA does not require so much and NMFS should have no problem determining that the lesser standard under the ESA has been met in this case.

This risk of misidentification is far from academic and has played itself out in fisheries data, trade data, and scientific studies for decades. Because experience indicates that individuals in fact do have difficulty differentiating between smooth and scalloped hammerheads in practice, it is highly likely that enforcement personnel in the United States, regardless of how well-trained, would as well. The species are simply too similar in appearance.

"Because of the difficulty in identification of these larger hammerhead species, catches of *S. lewini* are often amalgamated with *S. mokarran* and *S. zygaena*." (*see, e.g.,* E-CoP16-Prop-43 at 13; E-CoP15-Prop-15 at 13 ("Species specific landings data are lacking; hammerhead catches are often amalgamated as *Sphyrna* spp., and *S. zygaena* and *S. lewini* are often confused and misidentified.")). This is because "[r]eliable identification of species in these genera[, including hammerheads (genus *Sphyrna*),] can be difficult during fisheries sampling even for trained observers . . ." (Baum & Blanchard, 2010 at 231). This issue, discussed *supra* in conjunction with the difficulty in obtaining species-specific catch and decline information for the smooth hammerhead, shows that fishermen are unable to accurately differentiate these species and have instead chosen to amalgamate their catch data amongst the species.

In addition to amalgamating catch data, the scalloped hammerhead is in fact often affirmatively misidentified as a smooth hammerhead in the catch data as well (E-CoP15-Prop-15 at 3 ("Catches of *S. lewini* are often amalgamated as *Sphyrna* spp. or reported specifically as *S. lewini* or as *S. zygaena*.”)). Even in areas where the species are differentiated, the smooth hammerhead “has sometimes been confused with the Scalloped Hammerhead (*S. lewini*) in the tropics and these two species are probably misidentified with each other.” Casper, *et al.*, 2005; Camhi, *et al.*, 2007 at 63 (“This species has sometimes been confused with *S. lewini* in the tropics and these two species are probably misidentified with each other in some areas.”); E-CoP16-Prop-43 at 6 (“Estimates of trends in abundance of *S. lewini* are available for this species . . . Given the difficulties in differentiating species such as *S. lewini, S. mokarran*, and *S. zygaena* and the amalgamation of catch records, estimates of trends in abundance are also available for hammerheads as a complex.”). As a result of this differentiation difficulty, and citing sustainability concerns for both the smooth and scalloped hammerheads, ICCAT recommends not retaining, transshipping, landing, storing, or selling *any* hammerhead sharks, except for bonnethead sharks (*Sphyrna tiburo*), taken in the Convention area in association with ICCAT fisheries (ICCAT Recommendation 10-08).

This difficulty differentiating between smooth and scalloped hammerheads is also apparent in the trade of both species. As discussed, *supra*, “[i]n Hong Kong, the world’s largest fin trade market, *S. lewini* and *S. zygaena* (smooth hammerhead) are found under the ‘Chun chi’ market category, the second most traded fin category in the market” (NMFS, 2013 at 13 (citing Clarke, *et al.*, 2006a)). This is notable because this single shark fin market represents at least 50% of the global shark fin trade (Clarke, *et al.*, 2006a at 202 (citations omitted)). If even the greatest experts on shark fins cannot differentiate between these two species’ fins, then any enforcement personnel are likely to have substantial difficulty doing so.

Furthermore, Buencuerpo, *et al.*, 1998 refers to the single species of sharks in that study both as scalloped hammerhead and *S. zygaena*, which is the smooth hammerhead’s scientific name, interchangeably (Buencuerpo, *et al.*, 1998 at 678). This indicates confusion between the two species. This confusion, even among trained scientists in a published scientific paper is yet another indication that identification of these species is difficult, even for trained observers.

One study describes the difficulty in differentiating between these species as being:

> partly due to difficulties in easily distinguishing the three commonly fished species [(smooth, scalloped, and great hammerheads)], even as whole animals, especially when they are young. This identification problem is exacerbated when these animals are landed as headless and finless carcasses as is typical in commercial fisheries, and becomes severe to impossible for detached fins and other products such as meat and cartilage found in trade.

(Abercrombie, *et al.*, 2005 at 776 (citations omitted)).[21]

This section will focus on the two possible ways that enforcement personnel will encounter the species, either as complete or dismembered specimens, and how the similar appearance of these two

[21] Although this study discounts the apparent difficulty that at least some people have had even identifying these species to the correct genus, it is helpful in understanding the much more serious difficulty people will have in further identifying the sharks accurately at the species level.

species, in both states of completeness, makes differentiation between smooth and scalloped hammerheads difficult.

1. Close Resemblance of Complete Specimens

While it is common to land sharks as dismembered specimens, enforcement personnel will have substantial difficulty differentiating between smooth and scalloped hammerhead specimens even where they are landed or imported/exported as complete specimens.

a. Head Shape

Figure 23, *infra*, provides a comparison of head shapes between various hammerhead species. While the great hammerhead and bonnethead sharks have head shapes that, if representative and if present at the time in question, are at least somewhat distinguishable from the scalloped hammerhead, the smooth hammerhead does not. Contrary to its name, the smooth hammerhead does not actually have a smooth cephalophoil, but instead has a cephalophoil with a somewhat scalloped edge. The scalloped hammerhead's scalloped cephalophoil is its namesake and alleged differentiating feature. However, not only does the smooth hammerhead have a scalloped cephalophoil, even having a slight indentation in the center, but it also has a similarly shaped rounded edge on its cepaholophoil and a similar head to body ratio. Essentially, even if a smooth hammerhead were landed, or imported/exported, and presented to enforcement personnel with its head intact and undamaged, the differences in head morphology would not be sufficient to identify the species without substantial difficulty. This head shape is much more similar for smooth and scalloped hammerheads than for scalloped and great hammerheads.

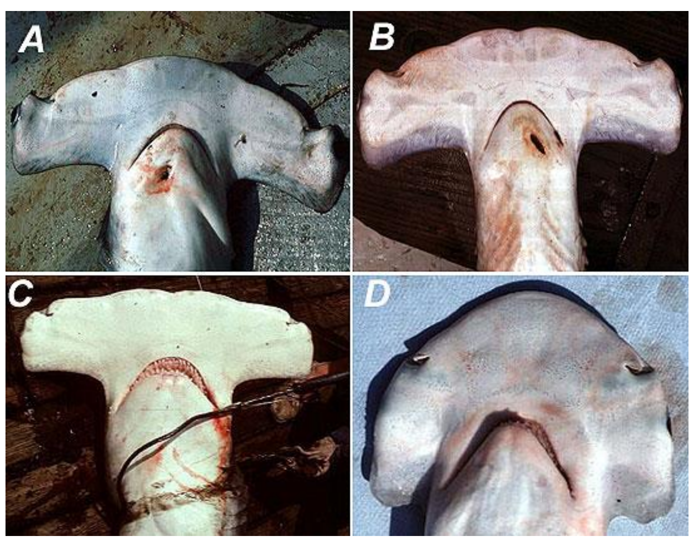


Figure 23. A) Smooth hammerhead; B) Scalloped hammerhead; C) Great hammerhead; and D) Bonnethead (Bester, Undated - 2).

b. Age at Capture/Size

NMFS' recent negative similarity of appearance decision for the great hammerhead was based in part on the fact that the great hammerhead, the largest hammerhead species, is significantly larger than the scalloped hammerhead and that this difference would aid enforcement personnel in differentiating between the two species. 79 Fed. Reg. at 33,525. Not only are the smooth and scalloped hammerheads closer in size, but, since both are typically caught well before they reach maturity, their relative size at capture, a relevant period for ESA similarity of appearance purposes, will be very similar, if not identical. Abercrombie, *et al.*, 2005 at 776 says that, while distinguishing between smooth, scalloped, and great hammerheads is difficult, even as whole animals, it is especially difficult to do so when they are young. Therefore, the smooth hammerhead's size weighs in favor of a positive similarity of appearance listing determination in this instance.

Ferretti, *et al.*, 2008 at 955 states that the maximum total length for scalloped hammerheads is 420 centimeters (13.8 feet) and that the maximum total length for smooth hammerheads is 400 centimeters (13.1 feet). This means that, over the species' entire lives, should they survive to their maximum total length, the scalloped hammerhead will only reach a size that is less than a foot more than the smooth hammerhead. One other source cites the smooth hammerhead's maximum size as 500cm, but this would still lead to less than 3 feet maximum total length difference between the species, even in the unlikely case that they were caught at their maximum size (*see* Bester, Undated).

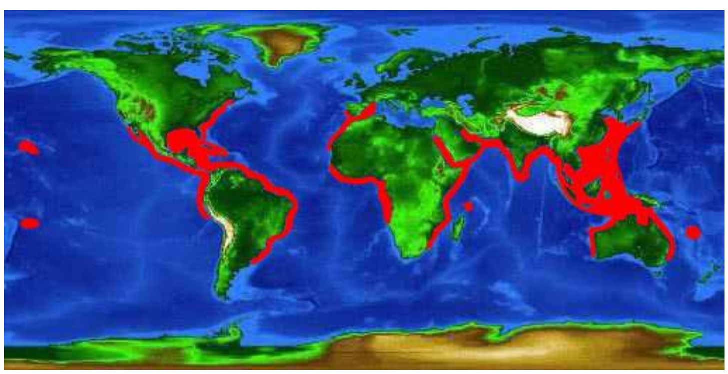
Even if the above differences in maximum total length were more substantial, these species are not being captured at their maximum total length and are instead often captured as neonates, juveniles, or young reproductively mature specimens. Differentiating between the smooth and scalloped hammerheads based on size at this stage would be impossible, especially where age was not exactly determinable. For instance, the European pelagic freezer-trawler fishery, which operates off Mauritania, Northwest Africa extensively bycatches hammerheads with 42% of their retained pelagic megafauna bycatch from over 1400 freezer-trawl sets consisted of hammerhead species (smooth, scalloped, and great hammerheads) (NMFS, 2013 at 15). "Around 75% of the hammerhead catch [in this fishery during the study period was] juveniles of [50-140 cm] in length." (NMFS, 2013 at 15 (citing Zeeberg, *et al.*, 2006)). If only, or mostly, juveniles are being caught, then differences in maximum size are useless in differentiating between the species. The sharks would be virtually identical in size at the ages at which most of them are caught and thus cannot be differentiated effectively based on size.

Another study assessing the longline and gillnet fisheries off the coasts of Spain and Africa and in the Strait of Gibraltar sampled landings from July 1991 to July 1992 and found that females were a mean size of 170 cm total length and males were a mean size of 150 cm total length in the longline fishery and a mean size of 220 cm total length in the gillnet fishery (NMFS, 2013 at 15 (citing Buencuerpo, *et al.*, 1998)). It is unclear whether this latter study refers to catch of smooth or scalloped hammerheads as it calls the sharks studied "scalloped hammerheads" and "*S. zygaena*," the scientific name for smooth hammerheads (*see* NMFS, 2013 at 15; Buencuerpo, *et al.*, 1998). Therefore, not only does this study show that the average size at capture is well below the species' maximum sizes, and therefore well within a size range that could be attributable to *either* species, but it also shows that even experts, here expert scientists in a published scientific article, have difficulty differentiating between these closely related species (*see* NMFS, 2013 at 15). In fact, of the sharks observed in this study, only 6% of males and 4% of females landed would even be considered mature (Buencuerpo, *et al.*, 1998 at 683). Observed sizes were instead largely within 114 and 256 cm total length (for males) and 114 and 304 cm total length (for females), sizes that could easily apply to either smooth or scalloped hammerheads (Buencuerpo, *et al.*, 1998 at 683).

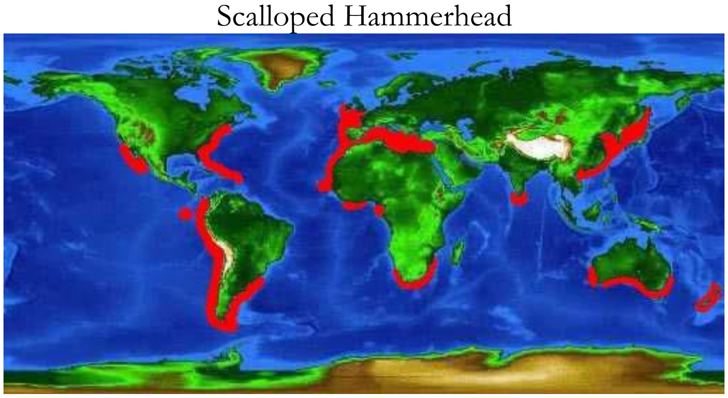
Differentiation of individuals based on size will be particularly problematic for inshore catch. This is because, "[i]n general, larger individuals dominate the catch in pelagic fisheries and juveniles are more common in the inshore catch." (Camhi, *et al.*, 2007 at 29 (citation omitted)). This inshore catch is already heavy in at least some areas and is increasing in others (Camhi, *et al.*, 2007 at 29 (citation omitted)). For example, coastal fisheries in the Southwest Atlantic already subject the smooth hammerhead to substantial bycatch pressure with juveniles being predominant in the catch (Camhi, *et al.*, 2007 at 29). This may also be the case for the charter boat catch occurring off the United States coast in the Northwest Atlantic and in the Eastern Pacific fisheries off the West coast of the United States (*see* IV. B. 2. Northwest Atlantic*, supra* (discussing charter boat fishing, which is likely done as daytrips with fishing occurring relatively close to shore); IV. B. 4. Eastern Pacific, *supra*). Finally, while these facts are evidence that distinguishing the species based on total size is likely impractical, the evidence that young specimens are being caught disproportionately also may further complicate identification as it is possible that the morphological differences that could be used to differentiate between these species may be less prominent, or indeed may be entirely absent, in young individuals, developing only as the individuals continue to mature.

c. Similar Oceanic Range and Depth Range

Both the smooth and scalloped hammerhead inhabit a similar, and often overlapping, range of oceanic locations and a similar depth range (*see* Camhi, *et al.*, 2007 at 29 ("*Sphyrna zygaena* and *S. lewini*['s] . . . ranges largely overlap."); Camhi, *et al.*, 2007 at 8 (scalloped hammerhead's depth range is 0-275 meters and smooth hammerhead's is 0-200 meters)). This means that enforcement personnel will often be unable to use capture locations or capture depths as a tool to help determine whether the specimen they are presented with is a smooth or a scalloped hammerhead.



Scalloped Hammerhead



Smooth Hammerhead

Figure 24. Maps indicating the ranges for the scalloped hammerhead (top, Bester, Undated – 2) and smooth hammerhead (bottom, Bester, Undated).

Similarly, fishermen will often have trouble determining whether the individuals that they catch are smooth or scalloped hammerheads based on what region and depth range they are from and this will likely encourage illegal, fatal retention of scalloped hammerheads under the belief that they are in fact smooth hammerheads.

2. Similarity of Appearance of Dismembered Specimens

Regardless of whether enforcement personnel could differentiate between smooth and scalloped hammerheads if they were able to observe the whole shark, this is not the way that enforcement personnel will typically encounter the species. In fact, many people engaged in the fin trade have never even observed a whole animal (Clarke et al 2006a at 202). Instead they see it after it has been rendered into fins or other products, thereby removing many of the distinguishing features (Clarke, *et al.*, 2006a at 202). As Abercrombie, *et al.*, 2005 notes, and as is covered in more detail *infra*, the differentiation issues are "exacerbated when these animals are landed as headless and finless carcasses as is typical in commercial fisheries, and becomes severe to impossible for detached fins and other products such as meat and cartilage found in trade." (Abercrombie, *et al.*, 2005 at 776).

Therefore, even if enforcement personnel theoretically could differentiate between complete smooth and scalloped hammerheads carcasses without substantial difficulty, this "complete shark" scenario is not the relevant "point in question," and the relevant point in question, where the sharks have typically already been rendered into their component parts, either "exacerbates" the identification issue or makes it "severe to impossible" (*see* Abercrombie, *et al.*, 2005 at 776; Clarke, *et al.*, 2006a at 202). For example, if a shark is landed as a headless, finless body, or its parts are imported/exported as part of the trade in shark fins, then it makes no difference whether the head shape is sufficiently distinct that, if the head were actually present, it would be able to be successfully and reliably identified by enforcement personnel. Morphological differences that enforcement personnel are not presented with are thus irrelevant at the relevant point in question.

a. Fins

Since sharks are typically landed or imported/exported in a dismembered state, often only as part of a shipment of fins or as fins of one species interspersed with many other undifferentiated fins, it is necessary to consider whether a smooth hammerhead landed or imported/exported in this way could be differentiated from a scalloped hammerhead without substantial difficulty. The answer is that it could not.

Hammerhead fins are morphologically similar, which allows fin traders in the Chinese and Hong Kong fin markets to generally distinguish hammerheads from other groups of sharks (Food and Agriculture Organization, 2012 at 39; E-CoP16-Prop-43 at 13, 18). However, "[s]calloped and smooth hammerhead fins cannot be distinguished, or are not distinguished, even with expert knowledge" and "[f]ins of all three hammerhead species [(smooth, scalloped, and great)] are quite similar, to the extent that separating them would be difficult for non-experts." (Food and Agriculture Organization, 2012 at 39). Therefore, fin traders do not differentiate between scalloped and smooth hammerhead fins in their sales and instead pool them into a single category for sale

(Food and Agriculture Organization, 2012 at 39; Clarke, *et al.*, 2006b at 1119 (stating the species are pooled and sold as "Chun Chi"); E-CoP16-Prop-43 at 18 (Chun Chi includes both smooth and scalloped hammerhead fins)). Even in the Hong Kong fin market, the largest fin market in the world, which likely employs some of the most experienced fin identifiers in the world, smooth and scalloped hammerhead fins cannot be differentiated from each other accurately 100% of the time (*see* Figure 26, *infra* (showing that 4% of the tested fins in the smooth hammerhead category, "Gui Chun," were in fact scalloped hammerhead fins)) and cannot even be differentiated from other sharks occasionally (*see* Figure 25, *infra* (showing that 4% of the tested fins in the smooth hammerhead/scalloped hammerhead amalgamated category, "Chun Chi," belonged to neither of those species). Also, it is unclear which fins were tested in these datasets as some would be easier to differentiate amongst than others. If only fins that are easier to positively differentiate, or fins that were sold in sets were included in these datasets, then this would skew results to more accurate determinations and may obscure even larger identification difficulties (*Compare, e.g.,* Abercrombie, *et al.*, 2013 at 17 (stating that "[t]he first dorsal fins of these two species[, scalloped and smooth hammerheads,] are almost indistinguishable."); Abercrombie, *et al.*, 2013 at 32 (discussing differences in the species' pectoral fins that are sometimes present)).

Trader's market category	*Hypothesized genetic identification*	*Samples tested*	*Samples with control failures*[a]	*Samples confirmed as matching the hypothesized species*	*A posteriori estimate*[b]		
					p	CV_p	s_p
Ya jian	*P. glauca*	37	1	35	0.97	0.028	0.027
Qing lian	*I. oxyrinchus*	69	2	57	0.85	0.051	0.044
Wu yang	*C. falciformis*	110	2	86	0.80	0.049	0.039
Hai hu	*C. obscurus*	34	0	29	0.85	0.071	0.061
Bai qing	*C. plumbeus*	40	6	25	0.74	0.103	0.076
Ruan sha	*G. cuvier*	26	1	21	0.84	0.087	0.073
Chun chi	*S. zygaena* or *S. lewini*	94	1	89	0.96	0.022	0.021
Gu pian	*S. mokarran*	35	0	30	0.86	0.069	0.059
Wu gu	*Alopias* spp.	75	7	50	0.74	0.073	0.054
Sha qing	*C. leucas*	53	3	32	0.64	0.106	0.068
Liu qiu	*C. longimanus*	23	0	23	1.00	0	0
Total		596	23	477			

[a] *Samples with control failures are those for which no positive control amplification could be obtained after several trials.*
[b] *The proportion of samples validating the hypothesized match is the a posteriori* p *value (equal to the number of matching samples per number of samples tested minus control failures).*

Figure 25. Testing results to confirm accuracy of fin identification in the Hong Kong fin market (Clarke, *et al.*, 2006a at 207). Chun Chi is the amalgamated smooth and scalloped hammerhead fin term.

Fin trade category	Genetically identified species
Chun Chi (n = 94)[a]	*S. lewini* (n = 56)
	S. zygaena (n = 33)
	Non-hammerhead taxa (n = 3)
Bai Chun (n = 35)	*S. lewini* (n = 33)
	S. mokarran (n = 1)
	Alopias pelagicus[b] (n = 1)
Gui Chun (n = 25)	*S. zygaena* (n = 24)
	S. lewini (n = 1)
Gu Pian (n = 35)[c]	*S. mokarran* (n = 30)
	S. lewini (n = 4)
	Non-hammerhead taxon (n = 1)

[a]DNA from 2 fins was unamplifiable by PCR.
[b]*A. pelagicus* was identified using a species-specific primer developed for this species as part of a separate study.
[c]Gu Pian results from Clarke et al. (in press).

Figure 26. Testing results to confirm the accuracy of fin identification in the Hong Kong fin market (Abercombie, *et al.*, 2005 at 784). "Gui Chun" is the market name for smooth hammerhead fins, "Bai Chun" is the market name for scalloped hammerhead fins, and, again, Chun Chi is the market name for amalgamated hammerhead fins.

The difficulty in differentiating between the fins of the two species is so extreme that fin guides often discuss the smooth and scalloped hammerhead's fin attributes in tandem. For instance, the CITES listing proposal states that "[s]calloped and smooth hammerhead 1st dorsal fins are so similar they are often extremely hard to differentiate." E-CoP16i-40 at 8; E-CoP15-Prop-15 at 11 ("According to Japanese fin guides, *S. zygaena* fins, which are morphologically similar to *S. lewini* . . .") (citation omitted)). In fact, NMFS' own shark fin guide states that "[t]he first dorsal fins of these two species[, scalloped and smooth hammerheads,] are almost indistinguishable." (Abercrombie, *et al.*, 2013 at 17). It then proceeds to treat them *in the same entry* (Abercrombie, *et al.*, 2013 at 17). NMFS even describes both species' fins as being "dull brown *or* light grey" in color (Abercrombie, *et al.*, 2013 at 7, 8 (emphasis added)). Therefore, even NMFS' training materials, the same materials that would be used by enforcement personnel as they attempt to differentiate between these species' fins, likely without having had much prior fin identification experience, will have literally no method of differentiating between the first dorsal fins. It is also important to note that this does not appear to merely be a shortcoming in NMFS' fin guide, but is a result of these fins actually being virtually indistinguishable by appearance (*see, e.g.,* Figure 27, *infra*). Furthermore, to the extent that these fins would have a slightly different shape, this shape can be altered by how the fins are cut or dried.

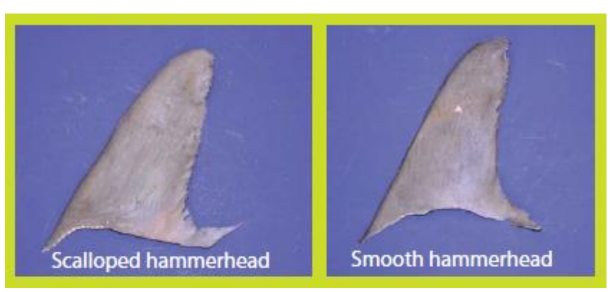


Figure 27. Scalloped and smooth hammerhead first dorsal fins treated in tandem in NMFS' own fin guide (Abercrombie, *et al.*, 2013 at 8).

NMFS' fin guide does provide a way to differentiate the pectoral fins if the fins are maintained as a set, as valuable fins sometimes are (Abercrombie, *et al.*, 2013 at 17; *see also* E-CoP16i-40 at 8 (stating that it is "not uncommon for valuable fins from an individual to be traded as a set," but also not saying that it is regularly done)). This guide explains that "[s]calloped hammerhead pectoral fins are similar in shape and color, but typically have a dark patch at the apex on the ventral surface that is absent from the pectoral fin of the smooth hammerhead." (Abercrombie, *et al.*, 2013 at 32). Therefore, even this sole fin used to differentiate the species' fins only "typically" has the coloration required to differentiate the species. The prevalence of this dark patch is not discussed, but this means that in <50% of cases, even where fins are sold as a set, the sole differentiating fin marker will be absent, making the fins virtually indistinguishable without DNA testing, which is impractical at customs locations (*see* Food and Agriculture Organization, 2012 at 39 (stating that DNA differentiation by enforcement personnel is impractical)). To say that in cases where fins are sold separately or where the "typical" black mark is not present on scalloped hammerhead pectoral fins enforcement personnel would not have substantial difficulty in identifying the species would defy credulity.

In addition, NMFS' fin guide makes no mention of identifying the species lower caudal lobe, so this fin may be able to be traded without risk of its being identified to the scalloped hammerhead as well (*see generally* Abercrombie, *et al.*, 2013; *see also* E-CoP16i-40 at 8 (stating that a fin set, where sold in that way, would include first dorsal, paired pectoral fins, and lower caudal lobe, but only providing for identification by the pectoral fins)).

In discussing the findings of Clarke, *et al.*, 2006(a), the FAO said that

> This study indicates that it is possible to identify shark fins in trade to species, with the important exception of scalloped and smooth hammerhead, which are not currently separated. However, expert knowledge and experience are doubtless required to attain the level of identification demonstrated in the China, Hong Kong SAR market. Accordingly, this study supports the argument that enforcement officers with general knowledge (possibly even with some additional identification materials) would have difficulty in identifying fins in trade to species. Available DNA technology could provide a backup to identification (Holmes, Steinke and Ward, 2009), but current technology is generally considered not to provide useful techniques for routine separation of species at customs posts.
>
> Scalloped and smooth hammerhead fins cannot be distinguished, or are not distinguished, even with expert knowledge. Fins of all three hammerhead species are quite similar, to the extent that separating them would be difficult for non-experts.

(Food and Agriculture Organization, 2012 at 39).

Fishermen, as well as those trading in shark fins, could easily exploit this similarity of fin appearance to import scalloped hammerhead fins into the United States under the guise of them belonging to smooth hammerheads.

b. Other Shark Products

Enforcement personnel will also have substantial difficulty differentiating between the meat, cartilage, oil, and leather of smooth and scalloped hammerheads. For instance, there is only one guide for identifying and differentiating fresh shark meat, and this guide is a Spanish language text that was created by the non-profit organization MarViva in 2012 (Food and Agriculture Organization, 2012 at 39). There do not appear to be English-language materials that United States enforcement personnel, or other non-Spanish speaking countries' enforcement personnel, could use to differentiate between hammerhead species' meat at this stage. Furthermore, even if such materials were available, "visual species identification based on processed shark products (in particular meat, cartilage and oil, lower lobe of caudal fin) is difficult and this could present a problem for customs officers." (Food and Agriculture Organization, 2012 at 39). This is problematic because hammerhead sharks are frequently used, not only as a source of fins, as discussed in section VIII. A. 2. a. Fins, *supra*, but also as a source of meat and as a preferred source of skin for leather and liver oil (Camhi, *et al.*, 2007 at 20; Figure 28, *infra*). Therefore, although enforcement personnel will likely be confronted with these processed shark products, it is unlikely that they will be able to accurately differentiate between processed shark products that came from smooth hammerheads and those that came from scalloped hammerheads.

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

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

Figure 28. Chart indicating that hammerhead meat and fins are frequently used and that hammerheads are preferred species for skin and liver oil (Camhi, *et al.*, 2007 at 20).

B. This Similarity of Appearance Poses a Threat to Scalloped Hammerheads

The difficulty in distinguishing between smooth hammerheads and the scalloped hammerheads from listed DPSs presents "an additional threat to an endangered or threatened species." 16 U.S.C. § 1533(e)(B). If the smooth hammerhead is not listed, then targeted catch and retained bycatch for the scalloped hammerhead will likely continue. Fishermen will be able to both knowingly and unknowingly exploit scalloped hammerheads because of this difficulty in identification, and this will preserve the market for scalloped hammerhead parts in circumvention of the species' ESA protections.

The species' similarity of appearance will allow traders to disguise scalloped hammerhead carcasses as smooth hammerhead carcasses by rendering them into their component parts to avoid detection. With a strong market demand for both smooth and scalloped hammerhead fins, targeted and retained incidental catch is guaranteed to continue. This creates an incentive for fishermen to attempt to mislead enforcement personnel so that they may retain their scalloped hammerhead products under the guise that they come from smooth hammerheads. This ability to use the species' similarity of appearance to intentionally evade the scalloped hammerhead's protections represents a serious threat to the scalloped hammerhead.

As the information discussed *supra* suggests, good faith misidentification of smooth and scalloped hammerheads is also common. Fisheries often aggregate the species and visual differentiation is impossible, even for experts, in many cases. As a result, fishermen will continue to unintentionally retain bycaught scalloped hammerhead carcasses, incorrectly thinking that they are unprotected smooth hammerheads. Where even experts often fail at correctly distinguishing between these two species, fishermen cannot be expected to do so reliably. While the point of inspection is certainly *a* relevant point in time at which the species' similarity of appearance poses a threat to the scalloped hammerhead, it is not *the only* relevant time. Another relevant time is at the time of capture as it is the only time where the species can be released alive. However, even where the species is identified and released alive, the time that it takes to make that identification is important and could be decreased if fishermen did not have to differentiate between the very similar smooth and scalloped hammerheads. This is because, even if the fishermen realized that the sharks they have caught are scalloped hammerheads and not smooth hammerheads and release them after they get the sharks on the boat, the scalloped hammerhead's extremely high post-release mortality rate would mean that nearly all of them would die regardless (*see* Gallagher, *et al.*, 2012 at 13; Camhi, *et al.*, 2007 at 28-29 (91.4% and 93.8% post-release mortality for scalloped and great hammerheads, respectively); Cortés, *et al.*, 2010 at 32 (85% post-release mortality observed for smooth hammerhead)). Therefore, the scalloped hammerhead's survival potential may be increased by easing the fishermen's identification burden and consequently aiding in the return of the species to the ocean as quickly as possible. However, allowing continued economic promise for smooth hammerhead fishing in their overlapping habitat and depth range will lead to increased scalloped hammerhead mortalities even where the species is ultimately identified and returned to the ocean dead or dying. The species fares no better if the fishermen's mistake is realized by enforcement personnel as it is too late to save the shark at that point. Not protecting the smooth hammerhead will certainly lead to continued targeting of hammerheads, many of which will turn out to be scalloped hammerheads and to continued fishing in the smooth and scalloped hammerheads' shared geographical and depth range.

While fisher misidentification poses its own problem and likely offers the only opportunity to avoid captured scalloped hammerhead mortality, difficulty in differentiating between smooth and scalloped hammerhead sharks by enforcement personnel also poses a threat to the scalloped hammerhead. If enforcement personnel cannot adequately differentiate between the two species then they will certainly allow scalloped hammerheads and their component parts to enter into domestic and international trade. This continued presence of scalloped hammerhead parts in international trade represents both lost individual specimens and, perhaps more importantly, a continued market incentive to capture and kill the species. So long as there is an ongoing opportunity to profit from killing scalloped hammerheads, there will be ongoing attempts to do so. The only way to remove the incentive to utilize the species is to ensure that misidentification and misrepresentation of the species will not allow them to enter into trade. So long as the smooth hammerhead is not listed and is traded freely, this will be impossible due to the difficulty of differentiating between the two species. Therefore, the similarity of appearance between the two species poses a threat to the scalloped hammerhead in this way as well.

In order to avoid misidentification of smooth and scalloped hammerheads that increases the threats to scalloped hammerheads, the smooth hammerhead should be protected under the ESA. Even where the sharks are retained as complete carcasses, a number of factors hinder differentiation between the two. For instance, the locations and depth ranges at which the species are caught largely overlap, their cephalophoils are very similar and may be damaged, or indeed entirely absent, upon inspection, and their age and size at capture would likely be almost identical. These differentiation issues only increase when the species have been rendered into their component parts. At that stage, the fins, meat, cartilage, oil, and hides would be virtually indistinguishable without DNA analysis, which is currently impractical in the field. So long as there is a market incentive to capture smooth hammerhead sharks, fishermen will unknowingly kill scalloped hammerheads thinking they are smooth hammerheads and will also be able to intentionally circumvent the scalloped hammerhead's ESA protections by representing that scalloped hammerhead carcasses and body parts actually belong to smooth hammerheads. This represents a threat to the listed scalloped hammerheads DPSs.

Finally, this threat is in no way hypothetical or theoretical. These two species have been confused in the world's largest shark fin market by shark fin experts, in scholarly articles in published scientific journals, and by fisheries data collectors throughout their range. NMFS' own fin guide in fact treats some of their fins in the same entries because they are virtually indistinguishable with the few telltale distinguishing features existing between the two only being present sometimes. Even if enforcement personnel could ultimately differentiate between smooth and scalloped hammerhead carcasses in some cases, which they likely cannot effectively do, fishermen are likely even less able to do so. This similarity of appearance is thus a threat to the species even if enforcement personnel would be able to positively identify some scalloped hammerhead carcasses during inspections. At the point that the shark is a carcass, the threat is already largely complete and, therefore, allowing capture and landings of the oft-confused smooth hammerhead would pose a threat to the listed scalloped hammerhead DPSs.

C. Listing the Smooth Hammerhead Would Substantially Facilitate Enforcement of the Scalloped Hammerhead ESA Listing

Listing the smooth hammerhead would "substantially facilitate the enforcement and further the policy" of the ESA. 16 U.S.C. § 1533(e)(C). If the smooth hammerhead were listed, then there would be less incidental catch of scalloped hammerheads due to reduced incentive to fish for sharks in their overlapping habitat and depth range. Additionally, fishermen would not be required to differentiate between the very similar species and would be able to return all specimens of both species back into the ocean as soon as possible, minimizing their post-capture mortality and helping to eliminate good faith scalloped hammerhead retention due to confusion of the species with smooth hammerheads. Enforcement personnel would be faced with the much easier task of merely having to distinguish between smooth/scalloped hammerhead carcasses, fins, and other products and the carcasses, fins, and other products from other sharks, without having to distinguish between the two species of hammerheads – a task that will be nearly impossible in many circumstances. As discussed, *supra*, it is particularly difficult to distinguish the fins, the most economically important part of the shark to fishermen and traders, of smooth and scalloped hammerheads after the fins have been removed from the carcass. As such, if the smooth hammerhead is not listed, then enforcement personnel would likely have to resort to DNA testing to distinguish the two species' fins, and probably other parts as well, which is impractical at present (*see* Food and Agriculture Organization, 2012 at 39).

Smooth and scalloped hammerhead products generate lots of economic activity in the United States, both through consumption of shark products and as an important transshipment stopover, which can only be effectively controlled if both species are listed. For instance, at least one study found that both smooth and scalloped hammerhead fins were showing up in shark fin soup for sale in the United States as recently as August 2012 (E-CoP16-Prop-43 at 18). This soup can sell for over $100 per bowl in the United States, and this high price creates an incentive to mislead enforcement personnel (Ortega, 2014). Additionally, between late 2014 and early 2015 at least three large shipments of endangered scalloped and petitioned smooth hammerhead fins from the Eastern Atlantic have traveled through the United States on their way from Costa Rica to Hong Kong (Inside Costa Rica, 2015; Costa Rican Times, 2015).[22] Not only does this represent a violation of the ESA, it also represents documented proof of nearly 1,100 kilograms (2,425 pounds) of smooth and scalloped hammerhead shark fins passing through the United States in less than three months (Inside Costa Rica, 2015; Costa Rican Times, 2015). The two shipments with available price information were worth a total of $79,068.48 and, as applying the price values from these shipments of between $30 and $156 per kilogram depending on quality of the fins shows, the third shipment, from February 20, 2015, would have been worth an additional $24,131.10-$76,603.80 depending on the quality of the fins (*see* Inside Costa Rica, 2015 (containing Dropbox link with various invoices proving these exports); Costa Rican Times, 2015; Yue Hing November, 2014 (November invoice and one source of pricing); Yue Hing December, 2014 – 1 (Costa Rican export certificate for December export); Yue Hing December, 2014 – 2 (December invoice and another source for pricing); Yue Hing December, 2014 – 3 (additional Costa Rican export certification for December export)). This means that these three shipments alone had a minimum total value of over $100,000 and a maximum total value of over $155,000. This shows that the United States is an important transshipment location for both species and that they are both transshipped together, increasing the opportunity to mislabel scalloped hammerheads fins and export them as smooth hammerhead fins.

Since smooth and scalloped hammerheads are significantly different morphologically from other sharks, but very similar in appearance to each other, listing the smooth hammerhead would aid in effective enforcement personnel identification and elimination of scalloped hammerhead products from trade. Therefore, listing the smooth hammerhead would make enforcement of the scalloped hammerhead's ESA protections and the ultimate protection of the species more effective by ensuring that scalloped and smooth hammerheads are not confused with one another and that enforcement personnel can efficiently and accurately ensure that scalloped hammerheads and their

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[22] While Defenders has documentation of these specific shipments, it is highly likely that there have been, and continue to be, additional shipments of fins that we are either unaware of or that have been mislabeled to avoid ESA compliance issues. In short, there is absolutely no reason to believe that these are isolated or unique incidences.

component products do not make it to market. Effective enforcement and protection of ESA-listed species further the goals of the ESA. Accordingly, should NMFS fail to list the smooth hammerhead in its own right, Defenders urges NMFS to protect the smooth hammerhead worldwide by listing it under the ESA based on its similarity of appearance to the scalloped hammerhead.

D. Listing All Smooth Hammerhead Populations Under Similarity of Appearance Listing Based on Their Similarity of Appearance to the Scalloped Hammerhead and/or Based on Their Similarity of Appearance to any DPS of Smooth Hammerhead that NMFS Lists

Should NMFS consider listing only certain smooth hammerhead DPSs under similarity of appearance to the listed scalloped hammerhead DPSs or should it consider listing only certain smooth hammerhead DPSs in their own right, then Defenders also requests that NMFS list all of the remaining smooth hammerhead DPSs under the similarity of appearance listing provisions. The exploitation of these species is international and protecting the species in a piecemeal fashion will encourage ongoing exploitation in contravention of the ESA protections afforded.

1. Similarity of Appearance Between the Smooth and Scalloped Hammerheads

For the same reasons described, *supra*, all of the smooth hammerhead populations are so similar in appearance to all of the scalloped hammerhead populations at the relevant point in time that their similarity of appearance poses a threat to the listed scalloped hammerhead populations and such that listing all of all of the smooth hammerhead populations would substantially facilitate enforcement of the scalloped hammerhead DPS listings. Instead of restating all of these facts, they are incorporated by reference here (*see* VIII. A-C, *supra*). However, in summary, the species are incredibly physically similar, especially when they have been rendered into their component parts, that they are regularly confused for each other by fin traders, enforcement personnel, scientists, and fishermen (*see* VIII. A. Close Resemblance, *supra*). By allowing continued exploitation of the smooth hammerhead, fishermen and traders will be able to continue, both knowingly and unknowingly, exploiting the listed scalloped hammerhead DPSs and enforcement personnel will continue to be unable to differentiate the two species, thereby posing an ongoing threat to the listed scalloped hammerhead DPSs (*see* VIII. B. This Similarity of Appearance Poses a Threat to Scalloped Hammerheads, *supra*). And, finally, listing all populations of the smooth hammerhead would substantially facilitate enforcement of the scalloped hammerhead DPSs' ESA listing because it would decrease incidental catch and decrease differentiation difficulties for fishermen, traders, and enforcement personnel, and thereby avoid excess listed species mortalities (*see* VIII. C. Listing the Smooth Hammerhead Would Substantially Facilitate Enforcement of the Scalloped Hammerhead ESA Listing, *supra*). Therefore, if NMFS fails to list the smooth hammerhead in its own right as an entire population or in any DPS, then NMFS should list all of the remaining smooth hammerhead populations under a similarity of appearance listing to the listed scalloped hammerhead DPSs.

2. Similarity of Appearance Amongst All of the Smooth Hammerhead Populations

a. Close Resemblance of All Smooth Hammerhead Populations

While the smooth hammerhead exhibits genetic differentiation amongst populations, these differences do not appear to be reflected in significant morphological differences that would allow specimens to be easily differentiated by population (*see generally* V. DISTINCT POPULATION SEGMENTS, *supra*). In addition, even if some morphological differences were apparent between populations, there is no indication that they would likely be present at the time that the shark is inspected by enforcement personnel as the sharks are typically presented in a dismembered state (*see generally* VIII. A. Close resemblance, *supra*). Furthermore, the scarcity of analyzed smooth hammerhead DNA samples and the limited areas that they are available from mean that there is inadequate information on the genetic differences of all of the different populations to enable even genetic testing to reliably differentiate between the populations (*see generally* V. DISTINCT POPULATION SEGMENTS, *supra*). As a result, even enforcement personnel with the best possible training would be entirely unable to verify whether a smooth hammerhead that they were presented with came from a listed or unlisted population. They would not just be similar in appearance, they would in fact be identical as far as anyone could tell.

b. This Similarity of Appearance Would Pose a Threat to Listed Smooth Hammerheads

The impossibility of distinguishing between smooth hammerhead populations would present "an additional threat to an endangered or threatened [DPS]." 16 U.S.C. § 1533(e)(B). If some smooth hammerhead populations are not listed and others are, then targeted catch and retained bycatch for the listed smooth hammerhead DPSs will likely continue. Fishermen and traders will be able to both knowingly and unknowingly exploit listed smooth hammerheads because of this difficulty in identification, and this will preserve the market for listed smooth hammerhead parts in circumvention of the DPSs' ESA protections.

As the information discussed *supra* suggests, identification amongst smooth hammerhead populations is either impossible or extremely difficult at present. Therefore, fishermen may intentionally take smooth hammerheads from a listed DPS because they will be able to disguise the origin of the specimen by saying that it came from an unprotected population of the species. If fishermen were to do this then there would be no way to prove them wrong. With a strong market demand for smooth hammerhead fins and other products, targeted and retained incidental catch in the absence of adequate protections is guaranteed to continue. This creates an incentive for fishermen to attempt to mislead enforcement personnel so that they may retain their listed smooth hammerhead products under the guise that they come from unlisted smooth hammerheads populations. This ability to evade the listed smooth hammerheads' protections would represent a serious threat to any listed smooth hammerheads. If enforcement personnel cannot adequately differentiate between listed and unlisted DPSs then they will certainly allow listed smooth hammerheads and their component parts to enter into domestic and international trade. This continued presence of listed smooth hammerhead parts in international trade will supplement the unlisted smooth hammerhead parts in trade and represents both lost individual listed specimens and, perhaps more importantly, a continued market incentive to capture and kill the species. So long as there is an ongoing opportunity to profit from killing listed smooth hammerheads, there will be ongoing attempts to do so. The only way to remove the incentive to utilize listed populations of the species is to ensure that misidentification and misrepresentation of the species amongst populations will not allow listed individuals to enter into trade. So long as some populations of the smooth hammerhead are not listed and are traded freely, this will be impossible. Therefore, the similarity of appearance between all of the smooth hammerhead populations poses a threat to any listed smooth hammerhead populations in this way as well.

In order to avoid misidentification of listed and unlisted smooth hammerheads that increases the threats to listed smooth hammerheads, all smooth hammerhead populations should be protected under the ESA. Even if enforcement personnel could ultimately differentiate between listed and unlisted smooth hammerhead carcasses somehow, which they likely cannot effectively do, the individuals would already be dead. At the point that the shark is a carcass, the threat is already largely complete and, therefore, allowing capture and landings of any smooth hammerhead would pose a threat to listed smooth hammerhead DPSs.

c. Listing All Populations of the Smooth Hammerhead Would Substantially Facilitate Enforcement of Any Smooth Hammerhead DPS Listings

Listing all smooth hammerheads would "substantially facilitate the enforcement and further the policy" of the ESA if NMFS lists any smooth hammerhead DPSs. 16 U.S.C. § 1533(e)(C). If the smooth hammerhead were listed in all of its populations, then fishermen would not have to differentiate between populations and would be able to just avoid all smooth hammerhead capture. Enforcement personnel would be faced with the task of having to distinguish between smooth hammerhead carcasses, fins, and other products and the carcasses, fins, and other products from other sharks, without having to face the likely impossible task of distinguishing between populations of smooth hammerheads. Since smooth hammerheads are significantly different morphologically from *most* other sharks, but seemingly identical in appearance across populations, this would aid in effective enforcement personnel identification and elimination of their products from trade. This would also allow enforcement personnel to use genetic evidence, in the rare cases where such use was feasible, to differentiate between smooth hammerheads and other sharks even though that DNA evidence would be unable to differentiate amongst listed and unlisted populations of smooth hammerheads as little genetic differentiation information exists for these varied populations. Therefore, listing all smooth hammerheads would make enforcement of any listed smooth hammerhead DPSs' ESA protections, and the ultimate protection of those DPSs, more effective by ensuring that smooth hammerhead populations were not confused with one another and that enforcement personnel could efficiently and accurately ensure that listed smooth hammerheads and their component products did not make it to market. Effective enforcement and protection of ESA-listed species further the goals of the ESA.

Accordingly, should NMFS decide to list any DPSs of the smooth hammerhead under the ESA, but not the population as a whole, either in their own right or based on their similarity of appearance to listed scalloped hammerhead DPSs, then Defenders urges NMFS to protect the remainder of the smooth hammerhead populations worldwide by listing all of the populations under the ESA based on the population's similarity of appearance to any listed smooth hammerhead DPS(s) or to the listed scalloped hammerhead DPSs respectively.

IX. CONCLUSION

The smooth hammerhead merits listing as an endangered, or alternatively as a threatened, species under the ESA. The species is declining throughout its entire range or a significant portion of its range and continues to face overwhelming threats from targeted fishing and bycatch (both retained and as a result of their high post-capture mortality rate). The species also faces threats from large pollutant loads that are degrading its habitat and that may cause disease. The smooth hammerhead currently receives inadequate regulatory protections throughout its range and requires ESA listing to ensure its survival. Without adequate protection, the species' limiting life history characteristics and predictable aggregations will combine with the other threats discussed and will likely cause the species' extinction. Defenders therefore requests that NMFS list the smooth hammerhead throughout its range as an endangered, or alternatively as a threatened, species under the ESA. If NMFS determines that certain populations of the species qualify as DPSs, but that the species does not qualify as endangered or threatened throughout all or a significant portion of its range, then Defenders requests that NMFS list those DPSs as either endangered, or alternatively as threatened, DPSs under the ESA. Should NMFS list the species in its own right, then Defenders requests that NMFS concurrently designate critical habitat for the species in U.S. waters as required by law. Should NMFS fail to provide the species with ESA protection in its own right, then Defenders requests that NMFS list the entire species based on its similarity of appearance to the listed scalloped hammerhead DPSs. However, should NMFS initially consider listing the species in any DPS, either in its own right or based on its similarity of appearance to the listed scalloped hammerhead DPSs, Defenders requests that all additional populations also be listed based on their similarity of appearance to any listed smooth hammerhead DPS and/or listed scalloped hammerhead DPS respectively.

On behalf of Defenders, thank you for your time and attention to the Petition, and we look forward to hearing from you shortly. If you have any questions, please feel free to call.

Sincerely,

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