PETITION TO LIST THE
Great Hammerhead Shark (*Sphyrna mokarran*)
UNDER THE U.S. ENDANGERED SPECIES ACT

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Petition Submitted to the U.S. Secretary of Commerce, Acting Through the National Oceanic and Atmospheric Administration and the National Marine Fisheries Service

<u>Petitioner:</u>

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INTRODUCTION

WildEarth Guardians hereby formally petitions the Secretary of Commerce (Secretary), acting through the National Marine Fisheries Service (NMFS), an agency within the National Oceanic and Atmospheric Administration (NOAA), to list the great hammerhead shark (*Sphyrna mokarran*) as "threatened" or "endangered" under the U.S. Endangered Species Act (ESA) (16 U.S.C. §§ 1531-1544). We request that NMFS list the species throughout its range; however, in the alternative, if NMFS finds that there are Distinct Population Segments (DPS) of great hammerhead sharks, we would request that those be listed under the ESA. Additionally, we request that NMFS designate critical habitat for the species in U.S. waters or areas of the high seas that are essential to the species' survival and recovery.

The great hammerhead shark is the largest of all hammerhead sharks and is found in warm temperate and tropical waters around the world. Great hammerhead populations are in severe decline; the International Union for Conservation of Nature (IUCN) lists great hammerhead sharks as "endangered" on the IUCN Red List. IUCN Red List 2010a, Exhibit 1 at 1.

The species faces at least five major threats. The first is the present and threatened destruction of great hammerhead habitat by pollution and anthropogenic climate change. The second, and most severe, threat is overutilization for commercial purposes from both incidental catch and targeted commercial fishing. Third, the accumulation of various toxins in great hammerheads is resulting in biological changes that can be categorized as a disease. Fourth, existing regulatory mechanisms are inadequate to address the ongoing unsustainable harvest and incidental bycatch of great hammerheads. Lastly, additional factors exacerbate these threats; great hammerhead sharks are biologically vulnerable to exploitation and human population growth will only intensify the current fishing pressure, which is already beyond sustainable levels.

Similar concerns led NMFS to issue a positive ESA 90-day finding on Guardians' Petition for the closely-related and similarly imperiled scalloped hammerhead shark (*Sphyrna lewini*). See NOAA 2011b, Exhibit 41. The present Petition for the great hammerhead should receive the same result. By protecting these apex predators, NMFS can help maintain biodiversity and ecosystem structure in the oceans that will have wide-ranging positive effects. Sharks are the wolves of the sea, and the loss of a top predator like the great hammerhead, while a tragedy in itself, could also have wide-ranging and disastrous effects on ecosystem function.

PETITIONERS

WildEarth Guardians is a nonprofit environmental advocacy organization that works to protect endangered and threatened species throughout the world. The organization has more than 5,000 members and over 18,000 supporters throughout the United States and in several foreign countries. It is currently focusing on marine species, including the great hammerhead, as part of its Wild Oceans campaign.

Endangered Species Act

Congress enacted the ESA to "provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved, [and] to provide a program for the conservation of such endangered species and threatened species . . . " 16 U.S.C. § 1531(b). Section 3 of the ESA (16 U.S.C. § 1532) defines key terms in the Act. Those relevant to this petition include:

1. "The term 'species' includes any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature." Id. § 1532(16).

2. "The term 'endangered species' means any species which is in danger of extinction throughout all or a significant portion of its range . . . " Id. § 1532(6).

3. "The term 'threatened species' means any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." Id. § 1532(20).

Criteria for Listing

Section 4 of the ESA sets forth five listing factors under which a species can qualify for listing as "threatened" or "endangered":

A. The present or threatened destruction, modification, or curtailment of 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.

Id. § 1533(a)(1).

In considering these factors, the Secretary must use only "the best available scientific and commercial information regarding a species' status, without reference to possible economic or other impacts of such determination." 50 C.F.R. § 424.11(b) (2012). A taxon need only meet one of the listing factors outlined in the ESA to qualify for federal listing.

Criteria for Listing Based on Similarity of Appearance

Even in the absence of the threats listed above, Section 4 of the ESA (16 U.S.C. § 1533(e)) additionally provides that the Secretary 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. "[S]uch 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. "[T]he effect of this substantial difficulty is an additional threat to an endangered or threatened species;" and

3. "[S]uch treatment of an unlisted species will substantially facilitate the enforcement and further the policy of this chapter."

16 U.S.C. § 1533(e)(A)-(C).

The great hammerhead's similarity of appearance to the scalloped hammerhead shark, which recently received a positive 90-day finding under the ESA from NMFS, therefore provides an additional ground upon which to list the great hammerhead as "threatened" or "endangered." See NOAA 2011b, Exhibit 41.

CLASSIFICATION AND NOMENCLATURE

Taxonomy. The taxonomy of the petitioned species is *Sphyrna mokarran* (Rüppell, 1837). ITIS undated, Exhibit 3 at 1. The full taxonomic classification is shown in Table 1.

Table 1. Taxonomy of *Sphyrna mokarran*. Source: ITIS undated, Exhibit 3 at 1.

Phylum	Chordata
Class	Chondrichthyes
Subclass	Elasmobranchii
Order	Carcharhiniformes
Family	Sphyrnidae
Genus	*Sphyrna*
Species	*mokarran*

Common Name. *Sphyrna mokarran* is known by the common names "great hammerhead," "squat-headed hammerhead," and "cornuda gigante." IUCN Red List 2010a, Exhibit 1 at 1; FMNH undated, Exhibit 2 at 2. Throughout this petition, the species will be referred to as "great hammerhead."

SPECIES DESCRIPTION

The great hammerhead shark is the largest of all the hammerhead species with adults averaging over 500 pounds and reaching lengths of up to 20 feet. FMNH undated, Exhibit 2 at 6. Typically, male great hammerheads mature at 7.7 to 8.8 feet (234 to 269 centimeters) and reach at least 11.2 feet (341 centimeters), while females mature at about 8.2 to 9.8 feet (250 to 300 centimeters) and reach at least 15.8 feet (482 centimeters). Compagno 1984, Exhibit 4 at 549. At birth, pups average 1.6 to 2.3 feet (50 to 70 centimeters) in length. Id.

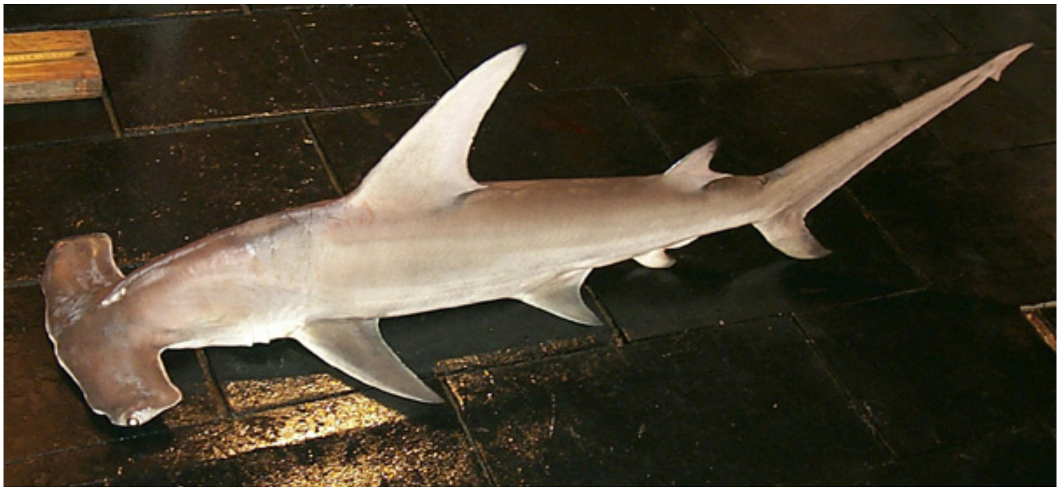

Figure 1. Great hammerhead.
Photo: NOAA/NMFS/Mississippi Laboratory.

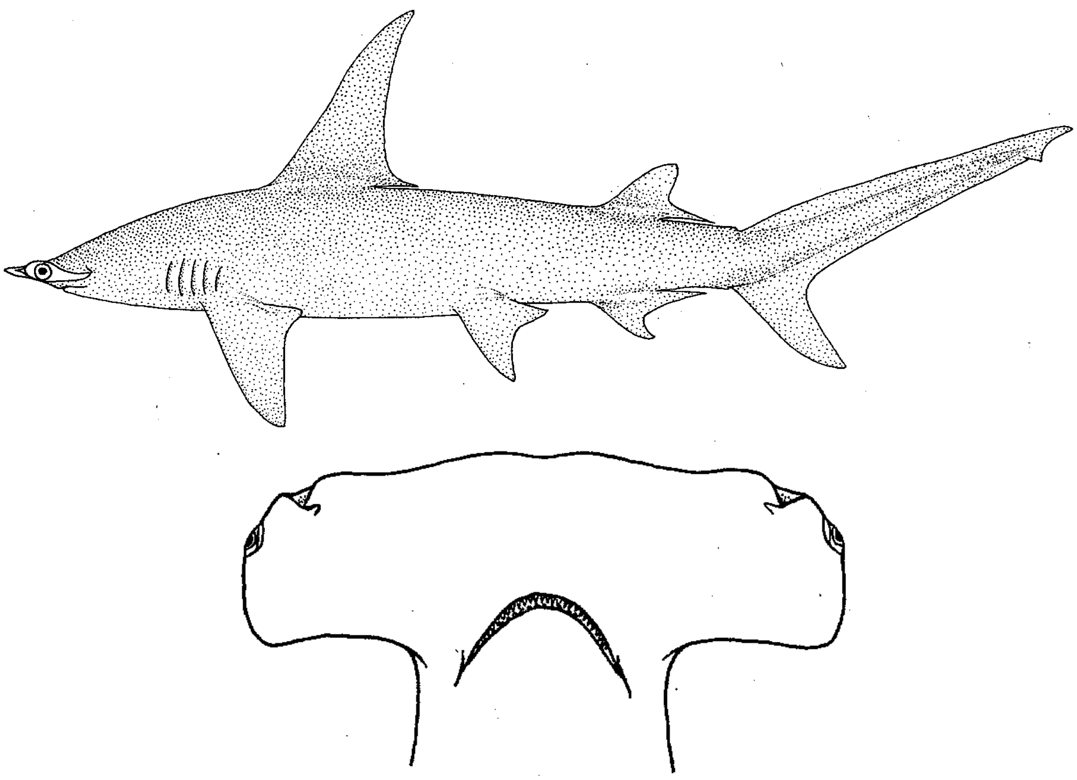

Figure 2. Sketch of great hammerhead.
Source: Compagno 1984, Exhibit 8 at 548.

The great hammerhead has a tall first dorsal fin with a strong falcate shape (i.e. curved like a sickle) and tall second dorsal fin with a deeply concave rear margin. FMNH undated, Exhibit 2 at 3-4. The pelvic fins are also concave and falcate in shape, in contrast to the scalloped hammerhead, which has straight posterior edges. Id. The posterior margin of the anal fin is also deeply notched. Id. The teeth of the great hammerhead are triangular and strongly serrated. Id. at 5.

The coloring of the great hammerhead shark is dark brown to light grey or olive on the dorsal side, gradually fading to white on the shark's underside. Id. at 4.

Distinctive Features. The nine related species of hammerhead sharks share a uniquely elongated and hammer-shaped head, or cephalofoil. Hammerhead species are differentiated from each other by variations in this cephalofoil. FMNH undated, Exhibit 2 at 4. Adult great hammerheads have nearly straight rear margins leading to a distinctly rectangular-shaped head. Id. at 3; MarineBio undated, Exhibit 5 at 1; Compagno 1984, Exhibit 8 at 548 (see Figure 2). By contrast, the rear margins on the cephalofoil of the scalloped hammerhead are slightly swept back. CITES CoP 15 Prop. 15 2010, Exhibit 6 at 5.

GEOGRAPHIC DISTRIBUTION

The great hammerhead is a circumtropical, highly migratory species found in warm temperate and tropical waters around the world. IUCN Red List 2012a, Exhibit 1 at 2; FMNH undated, Exhibit 2 at 2. It ranges from latitudes 40°N to 35°S. IUCN Red List 2012a, Exhibit 1 at 2. During the summer months, the great hammerhead migrates towards the poles in search of cooler waters. Id.

Specifically, in the western Atlantic Ocean, the great hammerhead is found from North Carolina in the United States, south to Uruguay, including the Gulf of Mexico and Caribbean Sea. FMNH undated, Exhibit 2 at 2; Compagno 1984, Exhibit 4 at 594. In the eastern Atlantic Ocean, it ranges from Morocco to Senegal, including the Mediterranean Sea. Id. In the eastern Pacific Ocean, the great hammerhead ranges from southern Baja California in the United States, south to Peru. Id. Lastly, the Indian Ocean range of the great hammerhead includes the Indo-Pacific region from Ryukyu Island to New Caledonia and French Polynesia. Id.

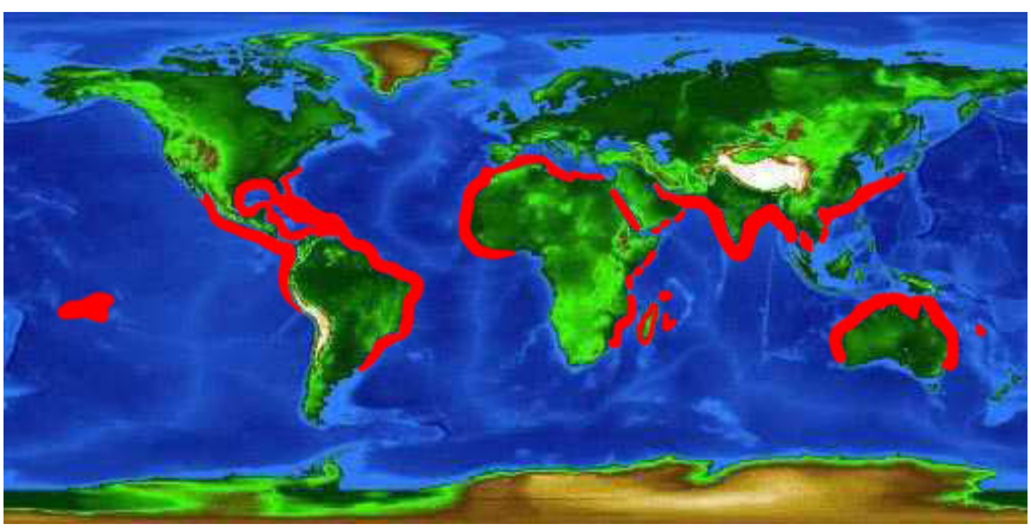

Figure 3. Global distribution of the great hammerhead.
Source: FMNH undated, Exhibit 2 at 2.

HABITAT REQUIREMENTS

The great hammerhead is a large coastal and semi-oceanic pelagic shark found in both coastal areas and deep offshore waters at depths of up to 300 meters. FMNH undated, Exhibit 2 at 2. It can often be found over continental shelves and in the lagoons and passes of coral atolls. IUCN Red List 2012a, Exhibit 1 at 2.

LIFE HISTORY

Expected life span of the great hammerhead shark is 20-30 years of age. FMNH undated, Exhibit 2 at 6-7. Adult great hammerhead sharks have no predators, but other larger sharks will target young sharks. Id. at 7.

Diet. Great hammerhead sharks prey upon a range of marine organisms, including invertebrates (crabs, squid, octopus and lobsters), bony fishes (flat-bodied fishes (skates and rays), tarpon, sardines, groupers, sea catfishes, jacks and grunts), as well as other sharks, including some cannibalism. FMNH undated, Exhibit 2 at 6; Compagno 1984, Exhibit 4 at 594. Stingrays are a particular favorite of the great hammerhead and it consumes these rays by pinning them down with the hammer end of its head. MarineBio undated, Exhibit 5 at 2. Great hammerheads use their highly developed electro-sensory system to locate prey and feed, which they do primarily at dusk. FMNH undated, Exhibit 2 at 6.

Reproduction and Dispersal. Like all species of hammerhead sharks, the great hammerhead is viviparous and gives birth to live young. FMNH undated, Exhibit 2 at 7. The gestation period is approximately 11 months, during which nutrition is delivered to the embryos via a yolk-sac placenta. Id. Pups are typically born during the spring or summer months in the Northern Hemisphere and litter sizes can be quite large: ranging from 6-42 young sharks. Id. The cephalofoil of young great hammerhead sharks is rounder and develops into the distinct rectangular shape of an adult only as it matures. Id. The great hammerhead is unique in that it reportedly mates near the surface, as opposed to most other sharks, which mate at or near the ocean floor. Id.

ECOLOGICAL ROLE

The great hammerhead, like most sharks, is an apex predator at the top of the marine food chain. Camhi et al. 1998, Exhibit 7 at 18. As scientists have noted, these top predators have "the potential to impact marine communities through direct and indirect interactions." Heithaus et al. 2007, Exhibit 8 at 1302. Accordingly, "[m]aintenance of biodiversity and ecosystem structure is another reason for controlling the indiscriminate destruction and fishing of chondrichthyans" because the loss of such a top predator could have wide-ranging and disastrous effects on ecosystem function. Camhi et al. 1998, Exhibit 7 at 18.

HISTORIC AND CURRENT POPULATION STATUS AND TRENDS

Great hammerhead shark populations have suffered tremendous commercial fishing pressure from both target and bycatch fisheries. IUCN Red List 2012a, Exhibit 1 at 3. In addition to extremely high bycatch mortality in incidental fisheries (greater than 90%), great hammerheads are also targeted for their characteristic large fins, which are prized in Asian seafood markets. Id. at 3-4. The fact that this species has such high market value likely leads to high retention rates of sharks caught incidentally as bycatch. Less than 10% of great hammerheads survive capture – many of that 10% are likely killed and stripped of their fins so that fishers can take advantage of the incidental profit. As a result of these fishing pressures, and in response to significant population declines, the IUCN recognizes great hammerheads as "endangered" globally. IUCN Red List 2012a, Exhibit 1 at 1. Under IUCN criteria, a species is considered "endangered" when it faces "a very high risk of extinction in the wild" and meets at least one of the criteria evidencing severe population decline. IUCN Red List Categories 2001, Exhibit 9 at 7, 9-11.

Species-specific population numbers for great hammerheads are rarely available. Camhi et al. 2009, Exhibit 10 at 29; Piercy et al. 2010, Exhibit 11 at 992. Due to the similar appearance and head shape among the species of hammerhead sharks, there is often confusion as to which hammerhead has been caught and catch numbers are typically reported at the genus level, e.g. *Sphyrna*. Camhi et al. 2009, Exhibit 10 at 29; IUCN Red List 2012a, Exhibit 1 at 3. However, population levels of all large hammerhead sharks "have registered significant declines in virtually all oceans." Camhi et al. 2009, Exhibit 10 at 29.

In the United States, this is partially due to the fact that great hammerheads are caught in the pelagic longline, bottom longline, and net fisheries in the Northwest Atlantic and Gulf of Mexico, as well as in the U.S. recreational fishery. IUCN Red List 2012a, Exhibit 1 at 4. Pelagic longline data from the U.S. Northwest and Western Central Atlantic shows that *Sphyrnidae* (including *S. mokarran* (great hammerhead), *S. lewini* and *S. zygaena*) populations have declined by 89% since 1986. Id.; Camhi et al. 2009, Exhibit 10 at 29.

In Central America and the Caribbean Sea, there is little available data. However, hammerhead sharks were heavily fished in the 1980s and early 1990s in the waters of Belize before a dramatic decline in the size and abundance of hammerheads led to closure of the fishery. IUCN Red List 2012a, Exhibit 1 at 4. Despite this action, illegal fishing in Belizean waters continues from neighboring countries. Id.

The Mediterranean Sea has experienced a greater than 99% decline of three *Sphyrna* species (*S. mokarran* (great hammerhead), *S. lewini* and *S. zygaena*) since the early 19th century. Camhi et al. 2009, Exhibit 10 at 29.

In the Eastern Atlantic off the coast of West Africa, the great hammerhead population is believed to have fallen 80% as a result of unmanaged and unmonitored fisheries. IUCN Red List 2012a, Exhibit 1 at 3; Camhi et al. 2009, Exhibit 10 at 29. As in other areas, great hammerheads are caught both as bycatch and as a targeted species in the Eastern Atlantic. IUCN Red List 2012a, Exhibit 1 at 3. While little specific data is available, the Sub-Regional Fishing Commission for West Africa released a plan of action for sharks, noting that landings of great hammerheads have collapsed and listing the species as one of the four most threatened species in the region and deserving of the greatest attention for recovery. Id. Accordingly, the IUCN assessed this population specifically as "critically endangered." Id.

In the Southwest Indian Ocean, the great hammerhead population has also declined sharply. The species is widely distributed throughout the Southwest Indian Ocean, but migrates in the summer to KwaZulu-Natal off the east coast of South Africa. Id. Data from KwaZulu-Natal show a 79% decline in great hammerheads in the past 25 years. Id.; Camhi et al. 2009, Exhibit 10 at 29; Piercy et al. 2010, Exhibit 11 at 992.

SIMILARITY OF APPEARANCE TO SCALLOPED HAMMERHEAD SHARK

As discussed in detail below, the great hammerhead faces all five of the identified threats set forth in Section 4 of the ESA. Guardians' petition for the closely-related scalloped hammerhead has received a positive 90-day finding under the ESA, meaning that it "presents substantial scientific information indicating the petitioned action of listing the scalloped hammerhead shark as threatened or endangered may be warranted." See NOAA 2011b, Exhibit 41. If the scalloped hammerhead is listed under the ESA, then the great hammerhead should be listed as well. The independent ground for such a listing is the similarity of appearance standard set forth in 16 U.S.C. § 1533(e). See Criteria for Listing based on Similarity of Appearance, above at 2. This standard provides that the Secretary may "treat any species as an endangered species or threatened species even though it is not listed pursuant to this section," when "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; the effect of this substantial difficulty is an additional threat to an endangered or threatened species; and such treatment of an unlisted species will substantially facilitate the enforcement and further the policy of this chapter." 16 U.S.C. § 1533(e).

First, the great hammerhead resembles the scalloped hammerhead shark so closely "that enforcement personnel would have substantial difficulty in attempting to differentiate between the listed and unlisted species." 16 U.S.C. § 1533(e)(A). This similarity of appearance was recognized in the proposal by the United States and Palau to list the scalloped hammerhead under Annex II of CITES, wherein the great hammerhead was listed as a "look-alike" species to be included under Annex II as well. CITES CoP 15 Prop. 15 2010, Exhibit 6 at 3. In discussing the endangered status of the scalloped hammerhead shark, the IUCN similarly noted that the inability to readily distinguish the great hammerhead from the scalloped hammerhead was "a large obstacle in the proper assessment of [the scalloped hammerhead] species." IUCN Red List 2012b, Exhibit 12 at 3. This difficulty in differentiating between the hammerhead species has been playing out in catch reporting for years. The similar appearance and cephalofoil shape among the species of hammerhead sharks has often led to confusion as to which hammerhead has been caught. As a result, catch numbers are typically reported at the genus level, e.g. *Sphyrna*, rather than determining which specific species of hammerhead has been caught. Camhi et al. 2009, Exhibit 10 at 29; IUCN Red List 2012a, Exhibit 1 at 3. Furthermore, processing the hammerhead sharks typically involves removing the fins and discarding the rest of the body. Thus, many identification clues, such as fin placement and cephalofoil shape, are unavailable to enforcement personnel. This is particularly important for hammerhead species as they are typically differentiated from each other by variations in their cephalofoils. FMNH undated, Exhibit 2 at 4. While fins are the most profitable hammerhead products, these identification difficulties also exist for a multitude of other items derived from these sharks such as jaws, teeth, fishmeal, and liver oil. Accordingly, enforcement personnel will experience even more difficultly attempting to differentiate between listed and unlisted species of hammerheads as they move past the initial capture stage and begin to be processed.

Second, the difficulty in distinguishing between great hammerhead and scalloped hammerhead sharks presents "an additional threat to [the] endangered or threatened species." 16 U.S.C. § 1533(e)(B). If the scalloped hammerhead shark is listed as "threatened" or "endangered" under the ESA, it will be imperative to protect the great hammerhead shark as well. Without this protection, fishing operations will be able to continue targeting great hammerhead sharks. This would present a substantial threat to the scalloped hammerhead, which will invariably be accidentally caught and landed due to the aforementioned difficulty of distinguishing between the two species, particularly on the high seas. FMNH undated, Exhibit 2 at 10. Furthermore, due to lack of easily identifiable features differentiating scalloped and great hammerhead shark parts – most importantly fins – after they are removed from the carcasses, it would be easy both for misidentification to continue and for fishers to continue to intentionally target scalloped hammerheads. Lack of protection for the great hammerhead would allow fishers capturing scalloped hammerheads to evade detection merely by marketing their fins and other products as belonging to great hammerheads. Therefore, if the scalloped hammerhead was protected under the ESA but the great hammerhead was not, this lack of protection would be an additional threat to the scalloped hammerhead.

The third and final criterion is also easily satisfied. Protecting both great hammerhead and scalloped hammerhead sharks "will substantially facilitate the enforcement" of protections for the scalloped hammerhead. 16 U.S.C. § 1533(e)(C). First, there will be less incidental catch of scalloped hammerhead because operations will no longer be able to target the great hammerhead. Second, enforcement personnel will be able to more readily identify and prevent the catch of the scalloped hammerhead species because such personnel will not have to distinguish whether the very similar fins and other products they are inspecting are those of the scalloped hammerhead or great hammerhead. Without protections for both species, enforcement personnel may have to go so far as to perform DNA testing to determine the species before they can enforce the ESA. As such, listing of the great hammerhead would make enforcement of scalloped hammerhead protection more effective, and more effective enforcement furthers the goals of the ESA.

Accordingly, if the scalloped hammerhead shark is listed under the ESA, Guardians urges the Secretary to determine that great hammerheads should also be protected, both worldwide and in any DPS NMFS determines to exist, and listed under the ESA based on their similarity of appearance to the scalloped hammerhead.

IDENTIFIED THREATS TO THE PETITIONED SPECIES: CRITERIA FOR LISTING

The great hammerhead shark meets all five of the criteria for listing identified in Section 4 of the ESA (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.

Coastal pollution from growing human populations focused in coastal areas and anthropogenic climate change threaten the great hammerhead's coastal habitat (Criterion A). However, commercial fishing, both targeted and bycatch, represents the primary threat to the species (Criterion B). The deposition of various pollutants into the oceans and their consequent bioaccumulation in, and damage to, sharks is a substantial threat to great hammerheads (Criterion C). Existing regulatory mechanisms are scarce and limited primarily to general finning bans, which have little to no impact on the depletion of the great hammerhead population (Criterion D). Finally, biological factors, such as infrequent reproduction, long gestation periods, and severe mortality rates from capture, and manmade factors, such as increasing human populations and anthropogenic climate change, make the great hammerhead particularly vulnerable to extinction (Criterion E).

<u>The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range (Criterion A)</u>

Growing Human Populations. Human populations have a substantial negative effect on shark habitat, particularly those human populations that are located near the coasts. "Contemporary sharks occur mostly where human population density is low." Ward-Paige et al. 2010, Exhibit 22 at 6. As coastal human populations grow, the negative effects on great hammerhead habitat will also increase.

Worldwide, approximately 2.5 billion people live within 100 km of the coastline (Burke et al. 2011, Exhibit 21 at 21). By 2020, an astonishing 75% of the expanding human population is expected to live within just 60 km of the coastline. Knip et al. 2010, Exhibit 25 at 2 (citation omitted). The negative impacts of this trend are exacerbated by the fact that impacts from this population growth do not occur linearly. Increased economic growth in coastal cities is a major cause of ocean habitat destruction. With growth comes an increase in consumption and development. This is reflected in an increase in construction projects, some of which occur on reef communities; dredging of harbors and shipping channels; dumping of waste, run-off of pollution and increased sedimentation; deforestation; and increased tourism. Research indicates that sharks around populated coastal areas are both smaller and less numerous, and that human population is also negatively correlated with the total number of fish present. Griffin et al. 2008, Exhibit 23 at 2. The coasts around virtually all urban areas are "beset by a pattern of pollution and over-development." Hinrichsen undated, Exhibit 24 at 2. "Coastal urban areas dump increasing loads of toxic wastes into the sea. In fact, waters around many coastal cities have turned into virtual cesspools, so thick with pollution that virtually no marine life can survive." Id. at 4.

This urban pollution is contributing to increasing "dead zones" – areas where dissolved oxygen content is so low that no marine life, apart from microorganisms, can live. A 2007 study identified 200 of these dead zones, an increase of 51 in just four years. Id. at 5. These dead zones are not only becoming more numerous; they are expanding. One striking example is the Gulf of

Mexico dead zone, the world's second largest, which has now reached the size of the state of New Jersey at 21,000 square kilometers. Id. These human population-related dangers pose real threats to great hammerheads, which rely on coastal areas and inhabit the Gulf of Mexico.

Furthermore, climate change is expected to magnify these coastal pollution problems. For example, "[d]ue to water circulation and oceanic volume changes, estuarine and coastal systems are predicted to experience . . . increased eutrophication, hypoxia, and anoxia." Roessig et al. 2004, Exhibit 29 at 258 (citations omitted). "More intense rains wash more fertilizer and sewage into coastal waters, and this runoff triggers algal blooms and consequent poisoning of fish and humans." Id. at 269 (citation omitted). This will cause new dead zones to emerge and already-existing dead zones to expand.

Coral reefs have already been exhibiting significant levels of deterioration due to anthropogenic impacts, and scientists believe that upwards of 70% of tropical and semi-tropical coral reefs, an important great hammerhead habitat, may be lost within the next 40 years. Hinrichsen undated, Exhibit 24 at 2. The Caribbean has been particularly hard hit, experiencing a four-fifths disappearance in coral reefs by 2003 with no signs of improvement since then. See Id. at 3. Damage to important coral reef habitat is already having profound impacts on shark populations. A recent University of Miami study found that reef shark numbers around populated islands, those where anthropogenic effects would be strongest, had dropped by more than 90% compared to those at the most pristine reefs. Nadon 2012, Exhibit 28 at 1. The researchers found that "[t]he pattern – of very low reef shark numbers near inhabited islands – was remarkably consistent, irrespective of ocean conditions or region." Id. at 2. In short, as human population, especially human population located near coasts and coral reefs, continues to increase, sharks, especially those that depend on fragile coastal ecosystems like the great hammerhead, will continue to lose habitat. This loss of habitat puts great hammerheads at greater risk of extinction.

Anthropogenic Climate Change. Climate change will not only affect great hammerhead habitat by exacerbating the effects of human-caused pollution, it will negatively impact great hammerhead habitat directly as well. "Global climate change is impacting and will likely increasingly impact marine and estuarine fish and fisheries." Roessig et al. 2004, Exhibit 29 at 269. "Extremes in environmental factors, such as elevated water temperature, low dissolved oxygen or salinity, and pH [all impacts predicted with anthropogenic climate change], can have deleterious effects on fishes." See Id. at 257 (citations omitted). As global climate change progresses, these environmental factors will continue to deteriorate, rendering more and more habitat unsuitable for great hammerheads.

Currently, the exact consequences of climate change for the oceans are not well understood, but the "hypothesis that coral reef communities are among the first to show signs of adverse climate change-related effects has been widely stated in the literature." Id. at 263, 265 (citations omitted). Coral reefs form important great hammerhead habitat, and their continued destruction will have deleterious consequences for the species. See IUCN Red List 2012a, Exhibit 1 at 2. "Corals are, quite obviously, central to coral reef ecosystems." Hoegh-Guldberg 2006, Exhibit 26 at 3. "To date, the study of potential effects of global climate change and inter-annual variation on coral reef communities have focused almost entirely on hermatypic (reef-building) corals, including 'bleaching' events." Roessig et al. 2004, Exhibit 29 at 263 (citations omitted). "Coral bleaching occurs when the photosynthetic symbionts of corals (zooxanthellae) become increasingly vulnerable to damage by light at higher than normal temperatures. The resulting damage leads to the expulsion of these important organisms from the coral host. Corals tend to die in great numbers immediately following coral bleaching events, which may stretch across thousands of square kilometers of ocean." Hoegh-Guldberg 2006, Exhibit 26 at Executive Summary. These bleaching events have been increasing both in terms of intensity and extent due to worldwide anthropogenic climate increases and will continue to cause severe damage to coral reefs. Id.

However, bleaching caused directly by temperature increase is not the only threat to coral reefs exacerbated by climate change. Certain coral diseases, harmful bacteria, and fungi may also damage this important great hammerhead habitat.

> Three coral pathogens (*Aspergillus sydowii*, *Vibrio shiloi*, and Black Band Disease) grow well at temperatures close to or exceeding probable host optima, suggesting that their population sizes would increase in warmer waters. Certain bacteria (e.g., *V. shiloi*) cause bleaching of certain coral species (e.g., *Oculina patagonica*), while fungi grow optimally at temperatures that coincide with thermal stress and bleaching in corals. This may lead to a co-occurrence of bleaching and infection . . . [T]he leftover dead coral surfaces can become colonized by macroalage, which support the proliferation of toxic dinoflagellates."

Roessig et al. 2004, Exhibit 29 at 269 (internal citations omitted).

Mass blooms of such dinoflagellates can cause destructive effects including toxic red tides. Latz Laboratory undated, Exhibit 27 at 2. Therefore, increased ocean temperatures mean a plethora of increased threats to corals, the reef ecosystems that depend on them, and the sharks, including great hammerheads, that depend on those ecosystems.

"Ultimately the only clear solution to this threat will be a concerted and successful global effort to reduce atmospheric greenhouse gas emissions and to stabilize atmospheric concentrations [of those gases] somewhere around or below current levels." Burke et al. 2011, Exhibit 21 at 31. So far, the U.S. has not been part of this solution. The U.S. Fish and Wildlife Service acknowledges this shortcoming in its "warranted but precluded" finding for the meltwater lednian stonefly, which is primarily threatened by climate change:

> The United States is only now beginning to address global climate change through the regulatory process (e.g., Clean Air Act). We have no information on what regulations may eventually be adopted, and when implemented, if they would address the changes in meltwater lednian stonefly habitat that are likely to occur in the foreseeable future. Consequently, we conclude that existing regulatory mechanisms are not adequate to address the threat of habitat loss and modification resulting from the environmental changes due to climate change to the meltwater lednian stonefly in the foreseeable future.

FWS 2011, Exhibit 39 at 18684, 18694.

With global temperatures already rising, no imminent solution to global climate change, and the negative effects on great hammerhead habitat that the lack of such a solution allows, there is both present and threatened destruction, modification, and curtailment of the great hammerhead's habitat and range due to climate change.

Overutilization for Commercial, Recreational, Scientific or Educational Purposes (Criterion B)

Great hammerhead sharks are heavily fished in both bycatch and targeted fisheries. This is undoubtedly the primary short-term threat to the species' continued existence. IUCN Red List 2012a, Exhibit 1 at 3; Camhi et al. 2009, Exhibit 10 at 29. Commercial fishing operations target the species for its large and highly valuable fins and great hammerheads are also regularly caught as bycatch in other fisheries. Camhi et al. 2009, Exhibit 10 at 29. Because great hammerheads have one of the highest bycatch mortality rates (greater than 90%), this amounts to a substantial population impact. Renshaw et al. 2012, Exhibit 13 at 101. Furthermore, due to their high-value fins, it is likely that many of those great hammerheads that would have otherwise survived incidental capture will be killed by fishers who profit by removing and selling their fins. These threats, coupled with the species' low reproductive rates, make great hammerheads particularly "vulnerable to over-exploitation and population depletion." IUCN Red List 2012a, Exhibit 1 at 1.

Bycatch Mortality. Great hammerheads are frequently taken as bycatch in longlines, bottom nets, hook-and-line and trawls. During these events they suffer an extremely high mortality rate of greater than 90%. FMNH undated, Exhibit 2 at 9; Renshaw et al. 2012, Exhibit 13 at 101. These "on-line mortalities" led the IUCN Shark Specialist Group on the Conservation Status of Pelagic Sharks and Rays to determine that "mandates for live release are not likely to be sufficient to offset fisheries mortality. Changes in fishing gear and methods, as well as the establishment of protected areas, are also needed to rebuild and conserve hammerhead populations." Camhi et al. 2009, Exhibit 10 at 28. Furthermore, these sharks have high value fins, teeth, and jaws, making it likely that even many of those that would have otherwise survived incidental capture will be kept and killed.

Targeted Fisheries. Although their meat is rarely consumed and has little value, great hammerheads are targeted by commercial fisheries for their large and valuable fins. FMNH undated, Exhibit 2 at 9; IUCN Red List 2012a, Exhibit 1 at 3-4. Both the size of their fins and the high needle count make hammerhead fins (including *S. mokarran*) highly prized in the shark fin trade. Camhi et al. 2009, Exhibit 10 at 28. They make up almost 6% of fins in the Hong Kong shark fin market and are the second most common species group in the international fin trade. Camhi et al. 2009, Exhibit 10 at 28; Piercy et al. 2010, Exhibit 11 at 992. And, if not simply finned and discarded by commercial fisheries, great hammerhead sharks provide liver oil used in vitamins, hides for leather, and are also ground into fishmeal. FMNH undated, Exhibit 2 at 9. Great hammerhead jaws and teeth fetch a high price as curios in stores and on internet sites such as eBay. A recent eBay search (December 3, 2012) found dozens of hammerhead shark teeth and jaws for sale. These items included several great hammerhead jaws listed for as much as $632.99.

In addition, recreational fishers target great hammerheads because they are considered to put up an "exciting" fight. FMNH undated, Exhibit 2 at 9. There is no evidence that this recreational fishery will be discontinued in the future independent of regulation, and, therefore, it represents an additive threat to great hammerhead survival.

Overfishing, therefore, continues to be the single greatest threat to the species, and, as described below, existing regulations are simply unable to check the unsustainable harvest of great hammerhead sharks.

Disease or Predation (Criterion C)

The addition of mercury, persistent organic compounds, heavy metals, and other pollutants to the oceans causes resultant physical effects on the bodies of large sharks that can be categorized as a disease. In studies of other shark species (specifically the great white shark, *Carcharodon carcharias*), scientists found that "[a]ll life-history stages may be vulnerable to high body burdens of anthropogenic toxins; how these may impact the population is not known." Domeier 2012, Exhibit 36 at 219-20. Mercury and organochlorine contaminants specifically may cause behavioral alterations, emaciation, cerebral lesions, and impaired sexual development that may already be affecting the survival of sharks. Mull et al. 2012, Exhibit 37 at 73.

Mercury. Mercury is released into the environment from industrial emissions, including those from coal-fired powerplants 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, Exhibit 31 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, Exhibit 32 at 447. In fact, one study showed that levels of mercury increase exponentially with size. Id. at 445. As the largest hammerhead, often reaching over 20 feet, and a very long-lived species, often living 20-30 years, great hammerheads are particularly susceptible to mercury accumulation and have been observed with exceptionally high levels of mercury in their tissue. See Id. at 443; FMNH undated, Exhibit 2 at 6-7.

One of the few studies to look specifically at mercury levels in hammerheads discovered that great hammerheads had among the highest mercury concentrations of any of the sharks tested, with levels exceeding 4 mg/kg. Lyle 1984, Exhibit 32 at 443. This value vastly exceeded the National Health and Medical Research Council standard for mercury in seafood of 0.5 mg/kg. Id. at 441. Great hammerheads were also found to have the highest weighted mean mercury compositions of any tested shark for both sexes. Id. at 447. Also, since great hammerheads are viviparous, female sharks directly transfer nutrients, and consequently mercury, through the placenta to ova and embryos. This means that great hammerheads are already experiencing mercury poisoning before they are born. One study found great hammerhead embryo mercury concentrations to be between 0.29-0.39 mg/kg, close to the aforementioned 0.5 mg/kg standard for seafood, even though they were still only in the embryonic stage. Lyle 1986, Exhibit 33 at 318-19. These studies were from 1984 and 1986 respectively, so, with increased mercury in the oceans, the mercury concentrations in great hammerheads are almost surely even higher now.

The great hammerhead's mercury accumulation problems are also exacerbated, as compared to many other shark species, by their habitat. The rate at which fish accumulate mercury from surrounding waters increases with rising water temperatures. Id. at 318. Since the great hammerhead is a circumtropical shark found in warm temperate and tropical waters around the world, it accumulates mercury more quickly than sharks living in cooler waters. See IUCN Red List 2012a, Exhibit 1 at 2; FMNH undated, Exhibit 2 at 2. 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.

The balance of mercury and selenium in the tissues of great white sharks tested in the Southern California Bight 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, Exhibit 37 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. Id. Due to the commonalities between the two species (including large size, longevity, and high trophic position), the threats to the great hammerhead should be assumed to be at least the same as those experienced by the great whites from this study. Unfortunately, the effects on great hammerheads are likely even greater since the great hammerhead lives in much warmer waters than the great white, thus allowing it to take up mercury more rapidly. Lyle 1986, Exhibit 33 at 318. This difference has played out in the observed mercury concentrations from these species; the great whites studied had average mercury concentrations in their blood of only 3.01mg/kg as compared to the 1984 great hammerhead concentration of 4.33 mg/kg, even though the great hammerhead observations were made nearly 30 years earlier when mercury concentrations in the ocean were over 30% lower. See Mull et al. 2012, Exhibit 37 at 59; Lyle 1984, Exhibit 32 at 443; Cone 2009, Exhibit 30 at 1.

One of the largest contributors to oceanic mercury is industrial emissions, including coal-fired powerplants. Cone 2009, Exhibit 30 at 1. In fact, burning of fossil fuels is the single largest source of mercury pollution in the world. MSNBC 2009, Exhibit 34 at 1. With the need for energy growing, mercury levels in the ocean have risen about 30% over the last 20 years. Cone 2009, Exhibit 30 at 1. A study conducted by scientists from Harvard University and the U.S. Geological Survey predict that the amount of mercury found in the Pacific Ocean will reach double 1995 levels by 2050 under current emission rates. Id. Increasing amounts of airborne mercury rise from Chinese power plants, cross the Pacific Ocean, and deposit on or near American shores. Geiger 2011, Exhibit 31 at 6-7. This trend suggests that the biological effects of mercury on great hammerhead sharks will only increase.

Polychlorinated Biphenyls (PCBs). "PCBs constitute a class of 209 compounds with differential biological activity and toxicity as a result of differences in the number and position of chlorine atoms. The so-called dioxin-like PCBs… exert a wide range of toxic responses particularly focused on the endocrine system, while the ortho-substituted congeners of PCBs, with two or more ortho-chlorines… seem able to produce neurotoxic effects." Storelli et al. 2003, Exhibit 35 at 1035 (citations omitted). PCBs accumulate in the fat of sharks and are present in sharks throughout the world. While the specific PCB loads present in great hammerheads have not been studied, those of the closely related smooth hammerhead (*Sphyrna* *zygaena*) were found to be very high, especially in the sharks' liver tissue. See Id. at 1037. The profile of PCBs in the sharks' bodies exhibited a higher proportion of more chlorinated PCBs in both muscle and liver tissues. Id. This concentration of more chlorinated PCBs poses significant neurological dangers for great hammerheads, as PCBs with two or more ortho-chlorines are thought to produce neurotoxic effects. Id. at 1035. Therefore, the PCBs present in the highest quantities in 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. Id. at 1035, 1037 (citations omitted). Therefore, since both neurotoxins are present in large quantities in great hammerheads, the risks to the species are greater than the risks posed by each neurotoxin separately. The study concluded by noting that, "the presence of PCBs and methylmercury, coupled with their synergistic activity, may make these organisms susceptible to long-term toxic effects." Id. at 1037.

Arsenic. High levels of arsenic have also been reported in hammerheads. Id. at 1036-37. This may be due to either to the sharks' diet or to a high capacity of the species to retain arsenic. Id. 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." Id. (citations omitted). Therefore, not only are these sharks at significant risk of serious neurotoxic effects from pollutants such as mercury and PCBs, they also are at an increased risk of cancer due to the extremely high levels of arsenic in their systems.

<u>The Inadequacy of Existing Regulatory Mechanisms (Criterion D)</u>

Existing international and domestic regulations have failed to adequately protect the great hammerhead. There are no specific international conservation measures for *Sphyrna mokarran*, and what limited regulations do exist cover hammerheads or large sharks more generally. IUCN Red List 2012a, Exhibit 1 at 4. As discussed below, finning bans are the most common form of regulation, and yet the United States has already recognized, with regard to the scalloped hammerhead, that "even with the increase and strengthening of finning bans, the lack of internationally enforced catch limits or trade regulations allows for the continued and unregulated fishing of [these sharks] in international waters." NOAA 2011b, Exhibit 41 at 72895. Because great hammerheads face similar threats, the same conclusion follows here.

Given the great hammerhead's extremely high bycatch mortality rate and the increasing demand for hammerhead fins in the Asian market, additional national and international regulations are imperative to protect the great hammerhead population from the current pressures placed on it by commercial fishing.

International and Regional Regulation. There is no international management of the great hammerhead shark population. The entire *Sphyrnidae* family, including the great hammerhead, is listed on Annex I (Highly Migratory Species) of the U.N. Convention on the Law of the Sea, which urges member states to implement cooperative species management. IUCN Red List 2012a, Exhibit 1 at 4. However, no such management has ever been implemented. Id.

In 2010, the United States and Palau issued a joint proposal to list the scalloped hammerhead under Appendix II of CITES (Convention on International Trade in Endangered Species). CITES

CoP 15 Prop. 15 2010, Exhibit 6 at 1. The proposal also included listing the great hammerhead and smooth hammerhead sharks because of their substantially similar appearance. Id. at 1-3. If adopted, the proposal would have provided international trade protections, including export permits and re-export certificates, partially restricting the trade in these three hammerhead species. CITES 2012, Exhibit 14 at 1. The proposal was rejected, however, and there are no CITES protections currently in place. NOAA 2011b, Exhibit 41 at 72895.

In 2011, the European Union similarly failed to gain protection for the *Sphyrnidae* family through two entities, the Indian Ocean Tuna Commission (IOTC) and the Inter-American Tropical Tuna Commission (IATTC). The proposals would have applied to all hammerhead sharks and prohibited "retaining on board, transhipping, landing, storing, selling or offering for sale any part or whole carcass of hammerhead sharks of the family *Sphyrnidae*" taken in an IATTC or IOTC area of competence. IATTC EU Proposal 2012, Exhibit 15 at 2; IOTC EU Proposal 2012, Exhibit 16 at 1.

In contrast to these failures, the International Commission for the Conservation of Atlantic Tunas (ICCAT) did adopt recommendations specifically prohibiting "retention, transshipping, landing, storing, or selling of hammerhead sharks in the family *Sphyrnidae*," which were in turn implemented by the United States. NOAA 2011a, Exhibit 40 at 53652. However, these are merely recommendations and do not do enough to bind the relevant actors.

A number of Regional Fishery Management Organizations (RFMOs) have at least adopted shark finning bans, including the International Commission for the Conservation of Atlantic Tunas (ICCAT), the Northwest Atlantic Fisheries Organization (NAFO), the Western and Central Pacific Fisheries Commission (WCPFC), and the IATTC. NMFS Shark Finning Report, Exhibit 17 at 36. However, these finning bans have little to no effect on shark mortality, as discussed below. In addition, no RFMOs have implemented catch limits for sharks on the high seas, nor have they implemented any Action Plans for sharks. Dulvy et al. 2008, Exhibit 18 at 474.

National Regulation. National regulation of great hammerhead sharks is largely limited to shark finning bans, which have been adopted in at least 19 countries, including the United States under the 2010 Shark Conservation Act. See Dulvy et al. 2008, Exhibit 18 at 474; 16 U.S.C. § 1857(P) (2010). In the U.S., great hammerheads are also covered under the Large Coastal Shark complex management unit in the NMFS Federal Fisheries Management Plan for Atlantic Tuna, Swordfish and Sharks, but this plan has no specific provisions for fishing of great hammerheads. IUCN Red List 2012a, Exhibit 1 at 4.

The IUCN noted that the adoption of shark finning bans "is accelerating and should increasingly prevent the harvesting of hammerhead sharks for their fins alone." IUCN Red List 2012a, Exhibit 1 at 4. However, such bans by themselves do not fully address the depletion of great hammerhead populations. As NMFS recognized for scalloped hammerheads, "even with the increase and strengthening of finning bans, the lack of internationally enforced catch limits or trade regulations allows for the continued and unregulated fishing of scalloped hammerheads in international waters." NOAA 2011b, Exhibit 41 at 72895. This premise applies with equal force to great hammerheads.

One shortcoming of these finning bans is that they are typically enforced by monitoring the fin-to-carcass weight ratio. However, many ratios are too high to be effective and contain loopholes to allow the continued removal of fins from sharks at sea. Dulvy et al. 2008, Exhibit 18 at 474. Finning bans alone only address issues of cruelty and waste and do little to reduce the number of sharks caught and killed. Id. This is particularly so in the case of great hammerhead sharks, which suffer extremely high bycatch mortality, even when not finned. FMNH undated, Exhibit 2 at 9; Renshaw et al. 2012, Exhibit 13 at 101. Enforced catch limits are needed to truly reduce hammerhead population depletion. Dulvy et al. 2008, Exhibit 18 at 474. Indeed, NMFS emphasized that, even though the United States recently strengthened its original finning ban with the 2010 Shark Conservation Act (requiring that all sharks be landed with fins naturally attached, *including* any fins purchased on the high seas), the need for "internationally enforced catch limits [and] trade regulations" remains. NOAA 2011b, Exhibit 41 at 72895.

The only country to date with any form of commercial limit for great hammerhead sharks is South Africa, which established a shark bycatch limit for its tuna longline fishery limiting shark bycatch to 10% of the weight of tuna landed. IUCN Red List 2012a, Exhibit 1 at 4. However, this limit still allows an immense number of great hammerheads to be caught and does not represent sufficient protection even in this limited area.

The existing regulatory mechanisms for managing the great hammerhead population are clearly inadequate. As the IUCN urged, "[p]recautionary adaptive collaborative management of target and bycatch fisheries is urgently needed for [the great hammerhead]. It is also essential to improve data collection and develop stock assessments for [great hammerheads]." IUCN Red List 2012a, Exhibit 1 at 4.

Protection under the Endangered Species Act would go a long way toward filling this regulatory gap. First, listing the great hammerhead as "threatened" or "endangered" would directly protect the populations in the Northwest and Western Central Atlantic region and in territorial waters in the Pacific, where the great hammerhead would be under U.S. jurisdiction. 16 U.S.C. § 1538(a)(1). Second, listing would prohibit the import or export of great hammerheads and their parts to or from the United States. Id. § 1538(a)(1)(A). Finally, listing would encourage international efforts to protect the great hammerhead by providing financial and technical assistance in developing conservation programs, as well as law enforcement assistance. Id. § 1537.

Other Natural or Manmade Factors Affecting Continued Existence (Criterion E)

There are additional natural and manmade factors threatening the survival of the great hammerhead and exacerbating the threats of overfishing, habitat loss, pollution, and inadequate regulation.

Biological Vulnerability. Several biological factors leave the great hammerhead particularly susceptible to overfishing. They are vulnerable to overutilization in part because they are a K-selected or K-strategy species (they are a large, long-lived species that reproduces infrequently and has a long period of gestation). See Goble & Freyfogle 2010, Exhibit 38 at 1058-60; IUCN Red List 2012a, Exhibit 1 at 1-3; FMNH undated, Exhibit 2 at 6-7.

> 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. Similarly, lower reproduction rates (which keep the population of a species in equilibrium with its environment) and a greater investment in individual offspring (which reduces the mortality of individual offspring) are more efficient uses of available energy because little is wasted on offspring that are unlikely to live to reproduce and because maintenance of population at capacity prevents habitat degradation while allowing the species to exploit available resources. 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, Exhibit 38 at 1059-60 (emphasis in original).

Great hammerheads are currently experiencing the type of rapid, chaotic change that makes their K-selected life history pattern a liability. This is because great hammerheads are not only losing habitat, but they are also being fished and removed from their remaining habitat at a rate greater than they can replenish their numbers. See "The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range (Criterion A)" above; "Overutilization for Commercial, Recreational, Scientific, or Educational Purposes (Criterion B)" above. Female great hammerhead sharks reproduce only once every other year and gestate for 11 months, on average, making the population especially slow to recover from depletion. IUCN Red List 2012a, Exhibit 1 at 1.

As a result of these pressures, many of the great hammerhead's physical attributes and reproductive adaptations have gone from being beneficial to creating increased risk of species extinction. The great hammerhead's 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. In addition, great hammerheads have one of the highest at-vessel bycatch mortality rates, greater than 90%. See Renshaw et al. 2012, Exhibit 13 at 101; Camhi et al. 2009, Exhibit 10 at 29. This extremely low survival rate makes the great hammerhead extremely vulnerable to fishing pressure, regardless of whether the fishing is targeted or incidental. IUCN Red List 2012a, Exhibit 1 at 4.

Human Population Growth. Because fishing, both targeted and incidental, remains the key threat to the continued existence of great hammerhead sharks, human population growth will only intensify this threat. The United Nations Population Division predicts an increase of over 3 billion people worldwide by 2100, raising the total human population to over 10 billion people. United Nations Population Division 2011, Exhibit 20 at 1. If left unchecked, this population growth will lead directly to increased fishing pressure on the great hammerhead population. This is because a larger human population will inevitably require more food, thus making increased fishing a virtual certainty. Also, as discussed in Criterion A, coastal human populations have a substantial negative effect on sharks from a pollution standpoint and human populations along the coasts are increasing rapidly. In fact, by 2020 75% of the expanded human population is expected to live within 60 km of the coastline. Knip et al. 2010, Exhibit 25 at 2 (citation omitted). This increased human population on the coasts will increase the pollutant load experienced by great hammerheads beyond already unsustainable levels.

Anthropogenic Climate Change. The negative coastal pollution effects discussed above will only be exacerbated by climate change. See Roessig et al. 2004, Exhibit 29 at 258, 269; "The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range (Criterion A): Growing Human Populations," above. Furthermore, climate change will continue to cause the destruction of important great hammerhead coral reef habitat through bleaching events and other impacts associated with increased concentrations of greenhouse gases in the atmosphere. See "The Present or Threatened Destruction, Modification, or Curtailment of Its Habitat or Range (Criterion A): Anthropogenic Climate Change," above. Anthropogenic climate change will also raise ocean temperatures and cause great hammerheads to absorb more mercury than they would in cooler waters, thus subjecting them to severe health problems associated with high levels of mercury in the body. See Lyle 1986, Exhibit 33 at 318; "Disease or Predation (Criterion C): Mercury," above. This increase in absorption efficiency will act in concert with the increasing concentrations of mercury in the oceans that are expected as energy needs continue to grow. See Cone 2009, Exhibit 30 at 1. Therefore, climate change represents a significant threat to the continued existence of great hammerheads.

CONCLUSION

The great hammerhead (*Sphyrna mokarran*) merits listing as an "endangered" or "threatened" species under the Endangered Species Act. This species is depleted or in decline throughout its range and continues to face overwhelming threats from overfishing – both targeted and bycatch. Great hammerheads are especially vulnerable to overfishing and species recovery is significantly hindered by the sharks' infrequent reproduction, long gestation period, and low survival after capture. In addition, these sharks face a variety of other human-caused threats relating to disease and habitat loss that are threatening to wipe them out. Current regulations are largely limited to finning bans, which, while helpful in reducing cruelty and waste, are inadequate to stem the unsustainable harvest and high bycatch mortality of great hammerhead sharks.

Listing the great hammerhead under the ESA would provide essential protection for this species by protecting shark populations in the Northwest and Western Central Atlantic and in territorial waters of the Pacific; prohibiting the import or export of great hammerhead fins in the United States; and providing financial, technical and law enforcement assistance for international conservation efforts. Whereas finning bans alone cannot address the substantial mortality rates of great hammerhead sharks, ESA protections would work directly towards slowing and reversing the population decline.

Sharks are the wolves of the sea, and the loss of a top predator like the great hammerhead could also have wide-ranging and disastrous effects on ecosystem function. By protecting these apex predators, NMFS can help maintain biodiversity and ecosystem structure in the oceans that will have wide-ranging positive effects, making listing of these sharks not only sound conservation, but also efficient policy-making and a crucial investment in the future of our oceans.

REQUESTED DESIGNATION

WildEarth Guardians hereby petitions the National Marine Fisheries Service within the National Oceanic and Atmospheric Administration to list the great hammerhead shark (*Sphyrna mokarran*) as an "endangered" or "threatened" species pursuant to the Endangered Species Act and to list any DPS NMFS may find to exist as well. This listing action is warranted, given that great hammerheads are threatened under all five ESA listing factors. In addition, if the scalloped hammerhead shark is listed, the great hammerhead would meet the similarity of appearance criteria in relation to the scalloped hammerhead. Petitioner also requests that critical habitat be designated for this species concurrent with final ESA listing. Scientists have recognized that, in addition to changes in fishing gear and methods, significant marine protected areas will need to be established to rebuild and conserve hammerhead populations. Camhi et al. 2009, Exhibit 10 at 28. Critical habitat should protect the areas most important to the great hammerhead's survival, such as breeding grounds and coastal areas including areas under U.S. jurisdiction on the southern U.S. Atlantic coast, in the Gulf of Mexico, and areas in the Pacific Territories, and areas of the high seas that are essential to the species' survival and recovery. See Figure 3, FMNH undated, Exhibit 2 at 2.

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