

PETITION TO LIST THE  
Dusky Shark (*Carcharhinus obscurus*)  
UNDER THE U.S. ENDANGERED SPECIES ACT



Dusky shark. Andy Murch/Elasmodiver.com ©

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

Petitioner:

WildEarth Guardians  
1536 Wynkoop Street, Suite 301  
Denver, Colorado 80202  
303.573.4898

November 9, 2012



## SUMMARY

WildEarth Guardians petitions the Secretary of Commerce, acting through the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service<sup>1</sup> (NMFS) to list the dusky shark (*Carcharhinus obscurus*) rangewide or the Northwest Atlantic/Gulf of Mexico distinct population segment as a “threatened” or “endangered” species under the Endangered Species Act (ESA).

The dusky shark is a large, wide-ranging warm-water shark that has been exploited without limit for its meat, fins, and cartilage, particularly since the late 1970s (SEDAR 2011a at 3). As a large shark, averaging 11.8 feet (3.6 meters) in length and inhabiting both coastal and pelagic waters, the dusky is particularly susceptible to the commercial fishing and finning that have caused its decline. In fact, experts have identified the substantial increase in fishing pressure as the “single greatest threat to all sharks” (Baum et al. 2005 at 10, 27-29). Fishing pressure, even under the most conservative models, threatens a third of all shark species (Morgan 2010 at 2-3), and may have already reduced the dusky shark to “the edge of collapse” (Romine et al. 2009 at 277).

Dusky sharks are vulnerable to population decline due to their low rates of growth and reproduction (Musick et al. 2007 at 4). Sharks are significantly more imperiled than other fish and marine wildlife that are proposed for listing or have already been listed under the ESA (Takahashi 2011 at 181-182, 191-192). The dusky shark is among the slowest maturing, and has one of the longest gestation periods, and lowest litter rates of all sharks<sup>2</sup> (Musick et al. 2007 at 4; Morgan 2010 at 1)

The international shark fin trade, an estimated \$73 billion market, threatens the dusky shark’s continued existence. “The high commercial value of shark fins led to the controversial practice of ‘finning,’ or removing the valuable fins from sharks and discarding the carcasses” (SEDAR 2011a at 1-3). Experts consider the dusky shark among the most “highly-desired” species in the international fin trade (Cortés et al. 2006 at 6, *citing* Clarke et al. 2006a).

Domestic and foreign regulators only started providing sharks meaningful protection in the late 1990s. Prior to that, commercial fisheries took a heavy toll on large and small shark populations (SEDAR 2011a at 5-6). The most optimistic models have estimated that fisheries have depleted current dusky shark populations to 62 to 80 percent of their virgin biomass<sup>3</sup> based on the 1960s baseline (SEDAR 2011a at 1-58). Other scientists have gauged dusky depletion at 79 percent of virgin biomass from a 1950s baseline (Baum and Myers 2004 at 142). Current take may be

---

<sup>1</sup> NOAA Fisheries.

<sup>2</sup> Compared to over twenty other shark species (also depleted by commercial fisheries), the dusky shark has the second-lowest growth rates to maturity (reaching maturity at 19 years for males and 21 for females), a long gestation period (12 or 22-24 months), among the lowest litter rates (3-14 pups per litter) (Camhi et al. 1998 at 32; Roberts 2005 at 27).

<sup>3</sup> Virgin biomass is a term that corresponds to a stock’s theoretical carrying capacity. It is defined as “[t]he average biomass of a stock that has not yet been fished (in an equilibrium sense). Biomass of an unexploited (or quasi unexploited) stock. Rarely measured. Most often inferred from stock modeling. Used as a reference value to [assess] the relative health of a stock, monitoring changes in the ratio between current and virgin biomass (B/B0)...” (NOAA 2006 at 59).

underestimated for dusky shark, as it is for other pelagic species.<sup>4</sup> Scientists estimate it could take 100-400 years for the Northwest Atlantic and Gulf of Mexico populations of dusky shark to recover, which by some scientific accounts renders the shark “Critically Endangered” (Cortés et al. 2006 at 50-51; SEDAR 2011a at 1-58).

Domestic fishers—commercial and recreational—directly target the dusky shark for meat and fins, and catch them indirectly as “by-catch” while fishing for tuna and swordfish. Specifically, fisheries have concentrated their efforts on juvenile dusky sharks, which has culminated in severe exploitation (98.8 percent of the subpopulation). There is some evidence that juvenile management is mitigating dusky shark decline to some extent. However, the increasing interest in the international market for fins appears to be offsetting this progress by reducing recruitment throughout the shark’s Northwest Atlantic/Gulf of Mexico range, and in its global distribution. The International Union for the Conservation of Nature (IUCN) lists the dusky shark as “vulnerable” and the Northwest Atlantic/Gulf of Mexico and Western Central Atlantic populations as “endangered” (Musick et al. 2007 at 1; Camhi et al. 2000 at 1).

Dusky shark populations continue to decline despite NMFS’ recognition of the shark as a “species of concern” and prohibition on take under the Magnuson-Stevens Fishery Conservation and Management Act (FCMA) since 1997 (NMFS 2011a). The shark has been assessed as recently as August 2011. While countries such as Australia and South Africa have also recently implemented management measures for the shark, no strictly-enforced and legally-binding action has been implemented for the dusky shark domestically or internationally.

## **DESCRIPTION OF PETITIONER**

WildEarth Guardians is a nonprofit environmental advocacy organization that works to protect wildlife, wild places and wild waters. The organization has more than 14,000 members and supporters and maintains offices in New Mexico, Colorado and Arizona. WildEarth Guardians has an active endangered species protection program. As part of this program, Guardians works to secure protection for a wide variety of imperiled wildlife and plants and the ecosystems on which they depend.

## **THE ENDANGERED SPECIES ACT AND IMPLEMENTING REGULATIONS**

The Endangered Species Act of 1973 protects plants and animals that are listed by the federal government as “endangered” or “threatened” (16 U.S.C. § 1531 et seq.). Any interested person may submit a written petition to the Secretary of Commerce requesting him to list a species as “endangered” or “threatened” under the ESA (50 C.F.R. § 424.14(a)). An “endangered species” is “any species that is in danger of extinction throughout all or a significant portion of its range” (16 U.S.C. § 1532(6)). A “threatened species” is defined as “any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range” (16 U.S.C. § 1532(20)). “Species” includes subspecies and distinct population segments of sensitive taxa (16 U.S.C. § 1532(16)).

---

<sup>4</sup> Poor domestic and even poorer international reporting (until the last decade), species misidentification and small sample sizes contribute to the problem of underestimated take (Dulvy et al. 2008 at 461, 465, 472; Shivji et al. 2001 at 1037; SEDAR 2011a at 111).

The ESA sets forth listing factors under which a species can qualify for protection (16 U.S.C. § 1533(a)(1)):

- 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.

A taxon need only meet one of the listing criteria outlined in the ESA to qualify for federal listing.

If the Secretary determines that a species warrants listing as “endangered” or “threatened” under the ESA, he is obligated to designate critical habitat for that species based on the best scientific data available (16 U.S.C. § 1533(b)(2)).

The NMFS and the USFWS have jointly published standards for defining a distinct population segment (DPS) (61 Fed. Reg. 4722). A species must be a vertebrate that is both discrete from other populations of the species and significant to the species as a whole. These terms are defined as follows:

**Discreteness:** 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.

**Significance:** 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 DPSs 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.

Id. at 4725.

Although these criteria are “non-regulatory” and serve only as policy guidance for the agencies, NMFS is committed to using these criteria for evaluating DPSs described in this petition (Id. at 4723).

#### CLASSIFICATION AND NOMENCLATURE

**Common Name.** *Carcharhinus obscurus* is commonly known as “bay-shark,” black whaler,” “bronze whaler,” “brown dusky shark,” “brown shark,” “common whaler,” “dusky ground shark,” “shovelnose,” and “dusky shark” (Knickle undated at 2). This petition refers to *Carcharhinus obscurus* as dusky shark.

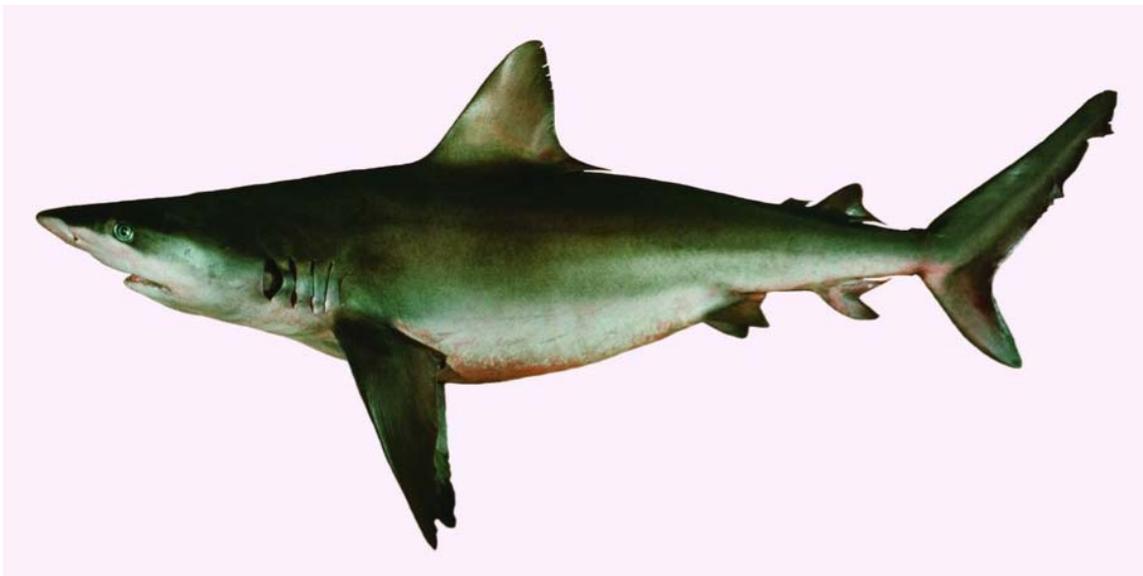
**Taxonomy.** Scientists first classified the dusky shark as *Squalus obscurus* in 1818, and later renamed the shark *Carcharhinus obscurus*, with *Carcharhinus* derived from the Greek “karcharos,” meaning “sharpen,” “rhinos,” meaning “nose,” and *obscurus* meaning “dark” or “indistinct” in Latin (Knickle undated at 1). The dusky shark has appeared in literature under many different names throughout history, including *Geleolamna greyi*, *Carcharias macrurus*, *Carcharhinus iranxae*, and *Carcharhinus obscurella* (Id.).

**Table 1. Taxonomy of *Carcharhinus obscurus*.**

Phylum	Chordata
Class	Chondrichthyes
Subclass	Elasmobranchii
Order	Carcharhiniformes
Family	Carcharhinidae
Genus	<i>Carcharhinus</i>
Species	<i>Obscurus</i>

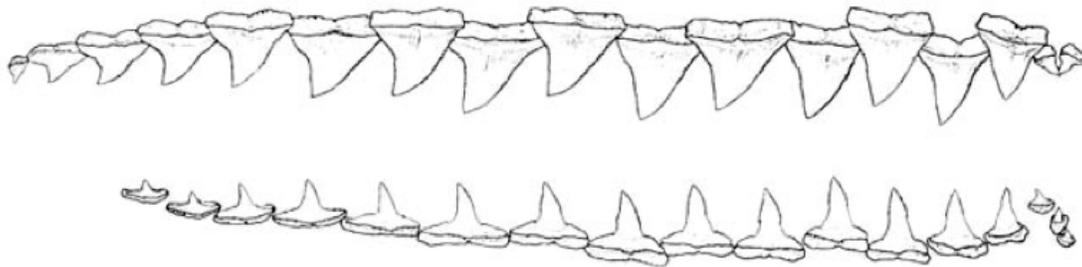
#### SPECIES DESCRIPTION

Sharks are a 400-million-year-old species of fish with skeletons lacking true bones (NMFS 2010 at 3-14). The dusky shark has a very large and relatively streamlined body with “dusky”-accented appendages (*see* Figure 1). The species’ average size and weight at maturity is 11.8 feet (360 cm) and 400 pounds (180 kg) (NMFS 2011a).



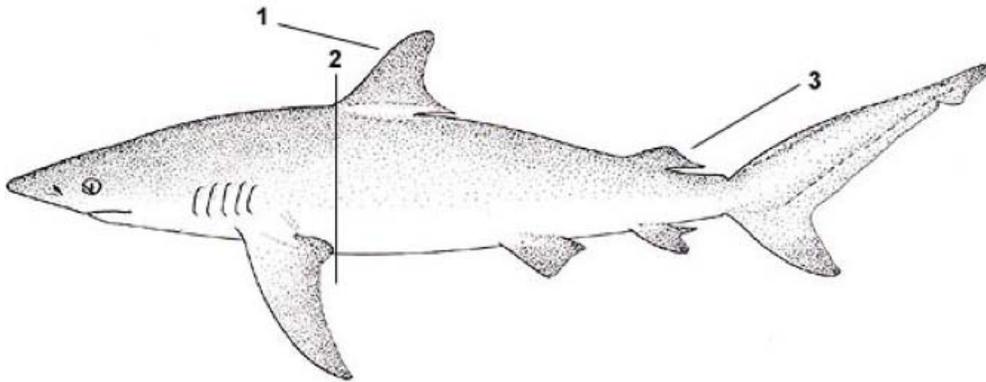
**Figure 1.** Dusky shark. Source: FAO 2012 at 1.

**Distinctive Traits.** The dusky shark distinguishes itself from other sharks with a short, broadly-rounded snout that is slightly shorter than, or as long as, the width of the shark's mouth (Knickle undated at 3). The shark's upper teeth are triangular and slightly oblique with serrated edges, and its lower teeth are erect, narrowly cusped, and more finely serrated (Id.).



**Figure 2.** Right upper and lower teeth of *Carcharhinus obscurus*. Source: Knickle undated at 3.

The dusky shark's eyes are circular and large, and it has long gill slits (FAO 2012 at 1). Other distinguishing features include (1) a sloping first dorsal fin; (2) a first dorsal fin that originates slightly before or over the free rear tip of moderately large pectoral fins; and (3) a second dorsal fin with a free tip length rarely more than twice its fin height (FLMNH undated at 1).



**Figure 3.** Distinguishing characteristics on the dusky shark. Source: FLMNH undated at 1.

### **GEOGRAPHIC DISTRIBUTION: HISTORIC AND CURRENT**

The dusky shark has a global but “patchy” distribution in tropical and warm temperate seas (Musick et al. 2007 at 2). Data on the dusky shark’s historic distribution are insufficient due to the common shortage of long-term data on shark fishing until as recently as the 1980s (Camhi et al. 1998 at 22; Baum and Myers 2004 at 135). However, researchers are increasingly determining the historical abundances of many large marine vertebrates, including sharks (Baum and Myers 2004 at 135-136). In fact, research indicates that the dusky shark was the second-most commonly targeted large shark in the 1950s and 1960s in the Gulf of Mexico, a significant portion of the dusky’s global range (Id. at 141). Researchers have determined that the dusky shark suffered a 79.2 percent population decline from the 1950s to 1990s (Id. at 142). Additional regional historic accounts of the dusky shark include those off the Mediterranean coast in the 1920s (Musick et al. 2007 at 1-2) and off the Australian coast in the 1940s (Id. at 2).

Today, the dusky shark occurs off the coast of southern Massachusetts to Florida, the Bahamas, and to the northern Gulf of Mexico in the Northwest Atlantic (FAO 2012 at 2). In the Eastern Pacific, the species occurs off the coast of southern California to the Gulf of California, but scientists know very little about the status of dusky shark in the Pacific, generally (see, e.g., Knickle undated at 3, 5 (referencing a Pacific population and assessing it as “vulnerable,” but not discussing it further); Musick et al. 2007 at 2-3 (referencing an eastern Pacific population, but offering no further information)). Along both U.S. coasts, the dusky shark undertakes long temperature-related migrations northward in summer and southward in autumn (Id.). During warmer months, juveniles occupy highly productive coastal nurseries from New Jersey to South Carolina (Romine et al. 2009 at 277). The longest recorded distance between the tagging and recapture of a dusky shark is 2,052 nautical miles,<sup>5</sup> and its longest recorded period at liberty is 15.8 years (NOAA 1998 at 133). The shark also occurs off the coasts and continental shelves of Nicaragua, southern Brazil, North Africa, South Africa, Madagascar, Japan, China, VietNam, and Australia (Musick et al. 2007 at 3).

---

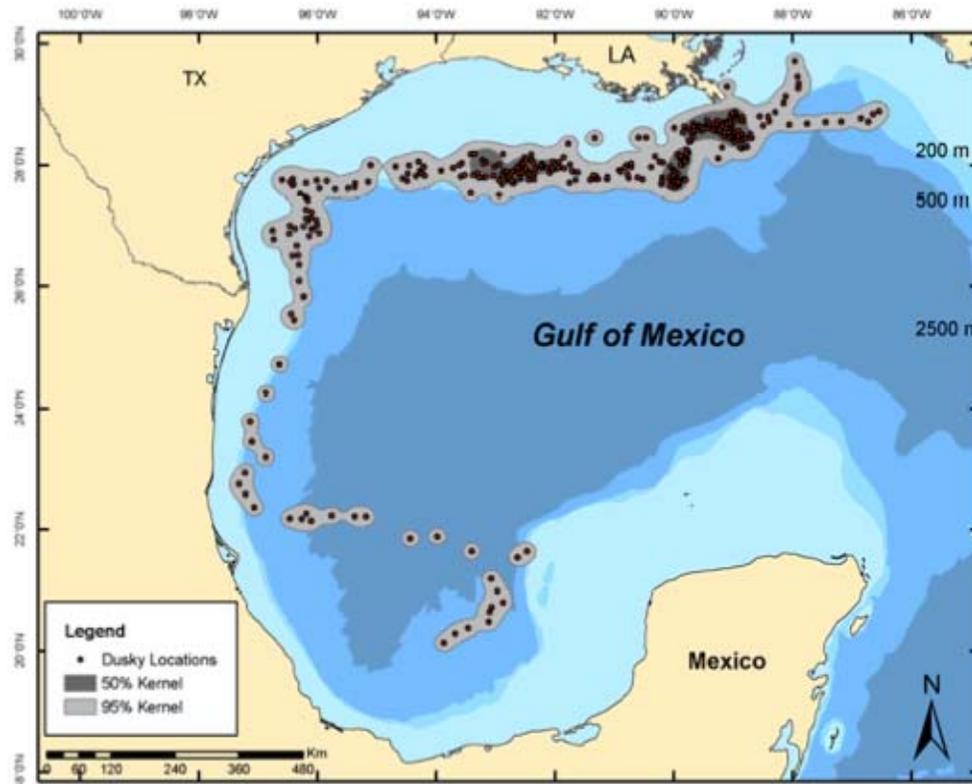
<sup>5</sup> Although adult migrations are longer than those of juveniles, scientists have recorded juvenile migrations as far as 742 nautical miles off the coast of South Africa (Musick et al. 2007 at 3).



**Figure 4.** Global range of the dusky shark. Source: Musick et al. 2007 at 3.

#### **HABITAT REQUIREMENTS**

Dusky sharks, as a coastal pelagic species, occur from the surf zone to the continental shelf, but do not undertake mid-ocean or transoceanic movements (See FAO 2012 at 2; NMFS 2010 at 3-15). Shelf edge habitat of undersea canyons appears to be important to the dusky (Hoffmayer et al. 2010 at 4; *see also* Figure 5). The dusky shark has an extremely large average home range of 30,899 km<sup>2</sup> (Id.).



**Figure 5.** Estimated home ranges of dusky sharks in the north central Gulf of Mexico. Source: Hoffmayer et al. 2010 at 10.

Young dusky sharks congregate in estuaries, very shallow coastal waters from New Jersey to Cape Hatteras, which are populated by commercially-attractive swordfish, tuna, and shark (Knickle undated at 2). The dusky shark prefers water temperatures ranging from 66-73° F (Ebert 2003 at 161). The species occurs from the surface to depths of 1,132 feet (400 meters) (Musick et al. 2007 at 3).

### **LIFE HISTORY**

The dusky shark is a large shark with a possible maximum length of 400 centimeters. Males mature at about 280 cm and reach at least 340 cm; females mature between 257 and 300 cm and reach at least 365 cm (FAO 2012 at 3). The dusky shark's productivity is extremely low (<0.04 per year),<sup>6</sup> consisting of very low growth rate, late maturity, large offspring, and long gestation periods, as discussed below.

**Diet.** The dusky shark “preys on a wide array of bony and cartilaginous fishes as well as a variety of invertebrates. Food items include herring, eels, mullet, groupers, grunts, croakers, bluefish, mackerel, tunas, various flatfish, a variety of sharks, skates and rays, crabs, octopuses, squid, starfish and sometimes human refuse” (Knickle undated at 4). “Young sharks mostly consume small pelagic fish (e.g., sardines and anchovies) and squid” (NOAA 1998 at 134).

<sup>6</sup> Hoffmayer et al. 2010 at 2, citing Natanson et al. 1995.

**Reproduction and Maturity.** Scientists do not completely understand the dusky shark’s reproductive cycle, but believe that the shark’s gestation period lasts up to 24 months and that females can give birth only once every three years.<sup>7</sup> The dusky shark, like some other Carcharhinids, nourishes its pups via a pseudo-placental sac during gestation, otherwise known as “viviparity”<sup>8</sup> (Knickle undated at 4). Pups are born at a large size, between 33 and 39 inches (70-100 cm), with litter size varying with geographic location from 6-14 pups.<sup>9</sup> “In contrast to fish that can lay millions of eggs, sharks depend on the long-term survival of only a few offspring to maintain viable populations” (Pew 2011a at 1). Western Atlantic dusky shark mating occurs in the spring (Knickle undated at 4; FAO 2012 at 2).

**Lifespan and Mortality.** Scientists estimate the maximum potential age of the dusky shark at 33 years, but note 40 years is possible where circumstances permit the shark to be at liberty for at least twelve years (Knickle undated at 3-4). Although there are no empirical mortality data, scientists estimate that the dusky shark has a natural mortality rate of 0.066 per year (SEDAR 2011b at 1, 2).

**Ecology.** Dusky sharks, as apex predators, are a vital component of diverse and healthy ecosystems (Shark Savers 2011, entire). Scientists agree that removal of apex predators from the food chain will likely lead to the collapse of marine ecosystems (*Id.*). Apex predators eliminate weak and sick individuals from prey populations, provide scavengers with food resources, and regulate the diversity, abundance, distribution, and behavior of prey species<sup>10</sup> (Griffin et al. 2008 at 1).

## **HISTORIC AND CURRENT POPULATION STATUS AND TRENDS**

Studies suggest that the dusky shark globally suffered a 64-92 percent decline in virgin biomass by 2004 (SEDAR 2011a at 58).

**Northwest Atlantic/Gulf of Mexico.** Although there is little data on the dusky shark’s historic range, there is information that it was the third-most commonly targeted large shark in the 1950s and 1960s (after the oceanic whitetip and silky sharks), undergoing a 79.2 percent decline from the 1950s to the 1990s in the Northwest Atlantic/Gulf of Mexico portion of its range (Baum and Myers 2004 at 141). Other analyses based on long-term survey data from coastal waters off North Carolina, data from the U.S. Atlantic pelagic longline fishery, and observer data from the Gulf of Mexico estimated population declines of between 70 and 98.8 percent over periods of 13–40 years (Musick et al. 2007 at 1). There is strong evidence that dusky shark populations were much more abundant in this region in the 1950s than the 1980s and 1990s, as scientists

---

<sup>7</sup> The lack of yolky ova in late-term females indicates a one-year resting period (NOAA 1998 at 133).

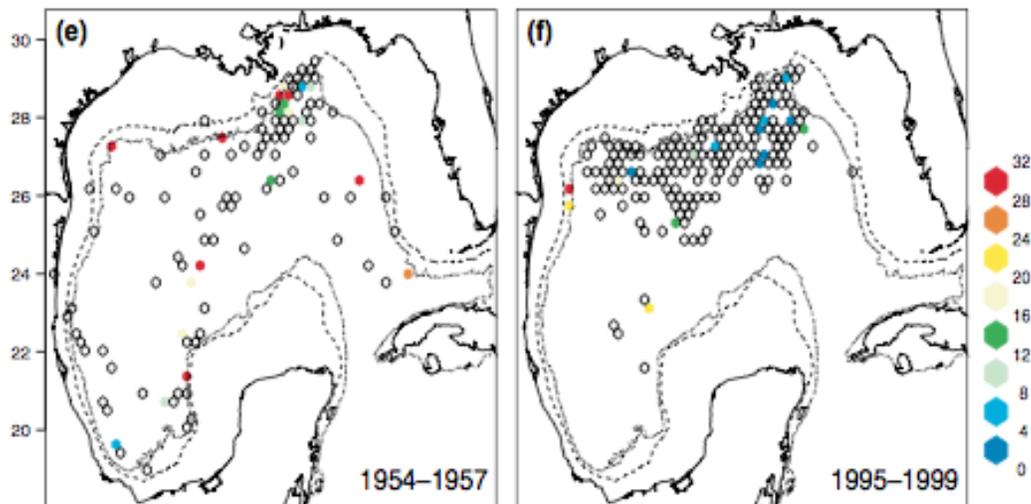
<sup>8</sup> Sharks produce young one of three ways: oviparity, by which eggs hatch outside the shark’s body; ovoviviparity, where eggs hatch inside the body; and viviparity or live birth (NMFS 2010 at 3-15).

<sup>9</sup> For example, in the western Atlantic, a litter size can range from 6-10 with an average of 8 pups, whereas in the southeastern Atlantic, the numbers are slightly higher, ranging from 6-14, with an average of 10 pups (Knickle undated at 4).

<sup>10</sup> Researchers have discovered a surge in cownose rays concurrent with a decline in the abundance of Northwest Atlantic sharks (Myers et al. 2007). Increased ray populations have led to a decline in bay scallops (*Id.*). Research suggests that this “cascading effect” may also eventually inhibit the recovery of clams and oysters in the region (*Id.*).

estimate that dusky shark catch rates were substantially higher in the 1950s than in the 1980s and 1990s, declining from a mean of  $0.61(\pm 1.72 \text{ SD})$  to  $0.16 (\pm 1.24 \text{ SD})$  (Baum and Myers 2004 at 141). Researchers also estimate the mean weight of the modeled dusky to have been much lower in the 1990s than in the 1950s (Id. at 141-142).

Recreational fisheries first contributed to the reduction of dusky shark populations in the Northwest Atlantic/Gulf of Mexico region in the late 1970s, particularly through Florida trophy shark tournaments (Musick et al. 2007 at 4). Commercial swordfish fleets also depleted the dusky shark indirectly as by-catch through pelagic longline<sup>11</sup> (PLL) fishing (Id.). Increased demand for shark fins sparked expansion of commercial fisheries in the U.S. in the 1980s and made the dusky shark a direct target of fishers (Id.). With the disappearance of the formerly abundant and now significantly depleted oceanic whitetip shark, “remaining catches are comprised of other depleted species, dusky, silky, and mako sharks, and by several species that were either extremely rare or not caught at all in the 1950s” (Baum and Myers 2004 at 142). The oceanic whitetip is primarily an offshore species whose entire population has been vulnerable to intense PLL fishing effort for over four decades (Id.). During that time, dusky sharks were partially protected from PLL fishing efforts that captured oceanic whitetips because those efforts only occasionally extended into offshore waters adjacent to continental shelves (Id.). However, fisheries are now increasingly catching dusky sharks along the Gulf Coast (Figure 6).



**Figure 6.** Map of Gulf of Mexico showing unstandardized mean catches per 10,000 hooks on yellowfin tuna targeted sets during the day in the 1950s (e) and the 1990s (f) for the dusky shark. Empty hexagons are set locations where none of the specified shark species was caught. Source: Baum and Myers 2004 at 137.

**Southwest Atlantic.** Although there is little population data on the dusky shark in the Southwest Atlantic, information on gear type and fishing effort is available. PLL and artisanal<sup>12</sup> fisheries

<sup>11</sup> Pelagic longline fishing is defined as fishing lines comprised of a “mainline that can stretch for tens of kilometers suspended by floats with branchlines, which are vertical lines attached to the mainline by a clip or swivel with a hook suspended below” (Cosandey-Godin and Morgan 2011 at 4, *citing* Brothers et al. 1999).

<sup>12</sup> The United Nations Food and Agriculture Organization defines artisanal fisheries as “traditional fisheries involving fishing households (as opposed to commercial companies), using relatively small amount of capital and

take the dusky shark both directly and indirectly in the Southwest Atlantic (Musick et al. 2007 at 5). The dusky shark comprised 1.12 percent of a Brazilian swordfish catch from July 1996 to February 1997 and 5.61 percent of the catch from 1996 to 1999 (Id.). A number of foreign fleets using PLL target the dusky shark directly and indirectly in the Southwest Atlantic, including fishers from Japan, China, Korea, Taiwan, Spain, the United Kingdom, Bolivia, and Barbados (Id.).

**Mediterranean.** There is little data available on population trends for the dusky shark in the Mediterranean and the IUCN has deemed the population “data deficient” (Id. at 2). Researchers rarely identify the dusky shark at fish markets, however this may be due to the fact that dusky sharks are often mistaken for other gray requiem sharks, such as the sandbar shark (*Carcharhinus plumbeus*) (Id.). Nevertheless, there are numerous accounts of dusky sharks taken as both target and bycatch along the North African and Sicilian coasts take dusky shark unsustainably, directly and indirectly, by PLL, gillnet,<sup>13</sup> artisanal, setline,<sup>14</sup> and tuna trap fisheries (Id. at 5).

**Australia.** The dusky shark occurs along the east and west coasts of Australia. Fishers established the Southwestern Australian Fishery in the 1940s but did not fully develop the fishery until the 1970s, at which point it yielded an annual catch of 500 to 600 tons (Id. at 5). The Southwestern Australian Fishery uses selective demersal gillnets<sup>15</sup> to target dusky shark neonates under three years of age, capturing 18 to 28 percent of all newborns in their first year (Id.). Dusky shark neonate takings increased from 100 tons per year in the late 1970s to approximately 600 tons per year in 1989 (McAuley et al. 2007 at 1710). The industry developed demersal longline shark fisheries off the northwest coast of Australia in the late 1990s (Id.).

**Indian Ocean.** The dusky shark occurs in the western Indian Ocean from the Red Sea to the southern tip of Africa and off the coast of Madagascar (Dudley et al. 2005). Adults occur off the South African coast of KwaZulu-Natal in water depths from 656 -1312 feet (200-400 meters), but swim in-shore seasonally (Id.). Juveniles occur in the surf zone and seasonally in the eastern and southern Cape (Id.). Fishers take the dusky shark mostly as PLL by-catch through tuna fisheries in this region, but also through small commercial line fisheries, and recreationally via long-line fishing and gillnet fishing (Musick et al. 2007 at 6). The dusky shark is the species fishers most commonly capture with gillnets off the coast of KwaZulu-Natal (Dudley et al. 2005).

---

energy, relatively small fishing vessels (if any), making short fishing trips, close to shore, mainly for local consumption. . . .” (FAO undated a at 1).

<sup>13</sup> Gillnet gear is “a type of fishing gear designed to entangle or ensnare fish by keeping the net near or at the surface with floats and allowing it to freely drift with the currents” (Cosandey-Godin and Morgan 2011 at 6, *citing* Hovgard and Lassen 2000).

<sup>14</sup> Merriam-Webster defines a setline as “a long heavy fishing line to which several hooks are attached in a series” ([www.merriam-webster.com/dictionary/setline](http://www.merriam-webster.com/dictionary/setline)).

<sup>15</sup> The IUCN defines a demersal gillnet as “16.5 to 17.8 cm stretched mesh” (Musick et al. 2007 at 5).

## ***Qualification of the Northwest Atlantic/Gulf of Mexico Population as a Distinct Population Segment***

Scientists recognize the Northwest Atlantic/Gulf of Mexico (NWA/GOM) as a genetically and geographically distinct subpopulation that would qualify as a DPS under the ESA. The Northwest Atlantic/Gulf of Mexico DPS of dusky shark is both discrete from other populations of the species and significant to the species as a whole.

**Discreteness.** NMFS considers the NWA/GOM dusky shark population to be distinct from all other populations. NMFS listed the NWA/GOM dusky shark as a DPS in the Federal Register when the agency revised its list of “species of concern” (71 Fed. Reg. 61022, 61024 Table 1). Scientists hypothesize that there is a single stock of dusky shark in the western North Atlantic Ocean based on migratory behavior and genetic data (Hoffmayer et al. 2010 at 2). Current dusky shark population reassessment studies also support the existence of a single, discrete stock in the NWA/GOM region, with tag recapture data showing a “high frequency of movements between [the NWA and GOM] basins” (Cortés et al. 2006 at 4; SEDAR 2011a at 1-59).

**Significance.** Because NMFS and other experts recognize the Northwest Atlantic/Gulf of Mexico DPS as a significant portion of the shark’s range (Morgan, pers. comm., Nov. 2011, *citing* Benavides et al. 2011) the loss of the DPS would result in a significant gap in the range of the taxon.

### **THREATS TO THE PETITIONED SPECIES**

The dusky shark meets at least four criteria for listing under the ESA rangewide and as a NWA/GOP DPS (bolded):

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

Historic and continued overfishing of this commercially valuable shark is a threat to the species (Factor B). The failure of the U.S. and other governments to adequately protect the species, along with a lack of international protection under the Convention on Trade in International Species (CITES) and other international agreements, also threatens the shark (Factor D). The dusky shark’s unique biological limitations and ecological constraints greatly compound threats from the other listing factors and hinder the shark’s ability to recover from historic and continued overutilization (Factor E). The 2010 Deepwater Horizon oil spill continues to threaten the shark with present modification of its habitat in the Gulf of Mexico (Factor A).

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

### **1. Rangewide**

The Gulf of Mexico comprises a significant portion of the dusky shark's range (Morgan, pers. comm., Nov. 2011). Experts concur that the 2010 Deepwater Horizon oil spill has harmed marine life in the Gulf, including the dusky shark. Experts listed sharks as one of ten "most vulnerable" species affected by the oil spill (Drapkin 2010 at 2). Camhi et al. (1998 at 10) also discussed the alarming rate at which developers in the U.S. and abroad were already destroying coastal habitat prior to the oil spill.

### **2. Northwest Atlantic/Gulf of Mexico DPS**

The Deepwater Horizon oil spill degraded the marine environment used by the NWA/GOM dusky shark. With over 4.9 million barrels (205.8 million gallons) spilled from April 10, 2010, to when the spill was capped on July 15, 2010,<sup>16</sup> scientists believe the Deepwater Horizon spill has caused and will continue to cause harm to coastal communities, including sharks, with physical and behavioral changes already noted in whale sharks (Handwerk 2010, entire). Researchers are studying the dusky shark for fatal and non-fatal impacts from the oil, including effects on fertility and the immune system (Hueter and Gelsleichter 2010 at 11; Hueter, pers. comm., Nov. 2011). Oil has degraded sea grass habitat south of Chandeleur Island, a known nursery for a number of shark species (CBD, undated). Additionally, sharks, as apex predators, bioaccumulate toxic chemicals they ingest from their prey base (Hueter and Gelsleichter 2010 at 3; Walker 2011 at 1).

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

### **1. Rangewide**

Experts have identified the substantial increase in fishing pressure as the "single greatest threat to all sharks" (Baum et al. 2005 at 29). Scientists have found the dusky shark "overfished" with "overfishing" occurring throughout the last decade, and as recently as 2011 (SEDAR 2011b at 1) despite specific regulations to recover the species.

#### **i. Domestic**

The dusky shark is subject to overfishing domestically (commercial, recreational, and as discards) throughout its range, including in the NWA/GOM and Pacific (SEDAR 2011b, entire). Fleets are also catching increasingly smaller dusky sharks, which scientists believe is accelerating depletion of the species (Cortés et al. 2006 at 13), as described further in Factor E, below.

---

<sup>16</sup> Hoch 2010 at 1; Welch 2010 at 1.

## 1. Commercial Exploitation

### a. Direct Catch

U.S. regulations foreclose direct capture and retention of dusky shark in U.S. waters because the shark enjoys “prohibited” status under the FCMA<sup>17</sup> (see Factor D), although commercial fishers continue to catch the shark through PLL and bottom-longline<sup>18</sup> fishing (Cortés et al. 2006 at 7). Furthermore, with the increasing demand for shark fins, largely in Asia, foreign fishers continue to exploit the dusky shark in U.S. waters through PLL fishing (Shivji et al. 2001 at 1045). Prior to the dusky shark’s “prohibited” listing, commercial fisheries mainly used longline vessels to directly target the shark, and these longlines have (unintentionally) continued to catch prohibited dusky sharks even after their listing (Cortés et al. 2006 at 12-13).

### b. Indirect Catch

The dusky shark’s “prohibited” status does not prevent domestic commercial fishers from taking the shark “incidentally” as by-catch through misidentification of the shark or otherwise. PLL is used to target swordfish and tuna, but often catches sandbar and dusky sharks, in particular, indirectly (SEDAR 2011a at 16). The sharks caught in these fisheries are often unregulated and unreported as regulations typically focus on the target species (e.g., tuna and swordfish) (Cosandey-Godin and Morgan 2011 at 4, *citing* Stevens et al. 2000). Furthermore, with the increasing demand for shark fins, largely in Asia, there is evidence that foreign fishers continue to exploit the dusky shark indirectly in U.S. waters through PLL fishing, particularly fishing for Atlantic tunas (Shivji et al. 2001 at 1045). Sharks as by-catch could account for as much as half of all shark landings (Cosandey-Godin and Morgan 2011 at 3, *citing* Stevens et al. 2000).

By-catch refers to “the incidental take of undesirable size or age classes of the target species, or to the incidental take of other non-target species or protected, endangered, or threatened species” (Cosandey-Godin and Morgan 2011 at 3, *citing* FAO 2010). By-catch can result in death or injury to the discarded fish, hinders restoration of overfished stocks, precludes other more productive uses of fishery resources, and affects the efficiency of fishing operations (FAO undated c at 1-2).

---

<sup>17</sup> Fishers may not take or sell “prohibited” sharks, commercially or recreationally, with the shark research exception (16 U.S.C. § 1801). Specifically, fishers cannot “possess” or “retain” the dusky shark “in any form” in commercial or recreational fisheries (NMFS 2011b). If a fisher catches a prohibited species such as the dusky, “it must be released immediately into the water with minimal injury and in a manner that maximizes its chances of survival” (*Id.*).

<sup>18</sup> Bottom longlines are similar to pelagic longlines, but “weighted so they are close to the bottom” (Cosandey-Godin and Morgan 2011 at 5).



**Figure 7.** Longline hooking of a dusky shark in the Bahamas at 6 meters.<sup>19</sup>  
© Malcolm Nobbs (2007)

Dusky shark juveniles experience a high mortality rate, with 82.4 percent found dead following longline capture (Morgan and Burgess 2007 at 3). Dusky sharks, in particular, have low survival rates when fishers catch them using commercial gear, due in part to the longer soak times that the commercial industry uses (Morgan 2008 at 55-56).<sup>20</sup> The number of reported discards is also likely an underestimate because sharks are not often brought aboard for positive identification (Cortés et al. 2006 at 28).

Shark “finning” is the practice of cutting off a shark’s fins and discarding the rest at sea (Pew 2011b at 18). Although several countries, including the U.S., have banned shark finning in their waters, sharks and rays comprised 25 percent of the overall catch between 1992 and 2003 in U.S. waters (Mandelman et al. 2008 at 428). There is evidence, even in U.S. waters, that fishers still regularly land dusky sharks, which they incidentally catch in tuna and swordfish fisheries, rather than release them, due to their high-value fins (Musick et al. 2007 at 4). The shark fin trade is responsible for killing up to 73 million sharks annually (Pew 2011b at 6). Economic, traditional and cultural factors drive the shark fin trade in China (Morgan 2010 at 4, *citing* Clarke 2004). Similarities in appearance can lead non-experts to confuse the dusky shark’s fins with those of the scalloped hammerhead, which the shark fin trade also highly covets (SSN 2010 at 2).

---

<sup>19</sup> Although the photographer was unsure of the type of catch occurring in this photo, it is likely longline pelagic gear targeting tuna and swordfish.

<sup>20</sup> Soak time is “the interval between the time the first hook entered the water until the first hook was removed from the water” (Morgan and Burgess 2007 at 2).

## **2. Recreational Exploitation**

Before the dusky shark was assigned “prohibited” status domestically in 1999, private anglers and charter boats directly targeted the species, particularly for show, in Florida in the 1970s and 1980s, leading to the initial depletion of the Northwest Atlantic/Gulf of Mexico DPS (Cortés et al. 2006 at 7).

### **ii. International**

Fishing has depleted dusky shark populations globally by 96 percent since 1974 (Baum et al. 2005 at 29). Humans have overutilized and continue to overutilize the dusky shark for largely commercial and recreational purposes throughout the shark’s international range, including the Northwest Atlantic, the Mediterranean, the Indian Ocean, and in Australian waters (Musick et al. 2007 at 4-6). Scientists concur that the shark fin market has contributed to the decline of the dusky shark internationally. The dusky is considered “one of the most highly desired shark species in the international fin trade” (Cortés et al. 2006 at 6, *citing* Clarke et al. 2006a). Shark fins are one of the world’s most valuable food items, reaching prices as high as \$700 per kilogram and generating \$400 to \$550 million a year in global trade (Morgan 2010 at 4, *citing* Clarke et al. 2007). Dusky sharks have one of the most sought-after fins for shark fin soup due to large fin size and high fin needle (ceratotrichia) content (Musick et al. 2007 at 4). The dusky shark represents at least 1.2–1.7 percent of the fins auctioned in Hong Kong, the world’s largest shark fin trading center (*Id.*). It is estimated that between 144,000 and 767,000 dusky sharks are represented in the shark fin trade each year or, in biomass, 6,000 to 30,000 million tons (*Id.*). Fishers also target dusky sharks for their meat, although shark meat is generally much less valuable than fins (US\$2.09 per kg and US\$1.94 per kilogram, respectively) (Morgan 2010 at 4, *citing* NMFS 2009).<sup>21</sup>

## **1. Commercial Exploitation**

### **a. Direct Catch**

Fleets in the Western Atlantic tuna and swordfish longline fisheries target sharks due to increasing demand for shark products and fins (Musick et al. 2007 at 5). In Australian waters, fishers use gillnets to target dusky shark neonates, seeking young flesh and fins and avoid catching sharks over three years of age (*Id.*). In South African waters, fishers use small commercial lines and gillnets (*Id.* at 6). They also use beach meshing to catch juveniles and adolescents (*Id.*). However, the large mesh size of the nets results in fishers taking many adult and sub-adult dusky sharks, as well (*Id.*).

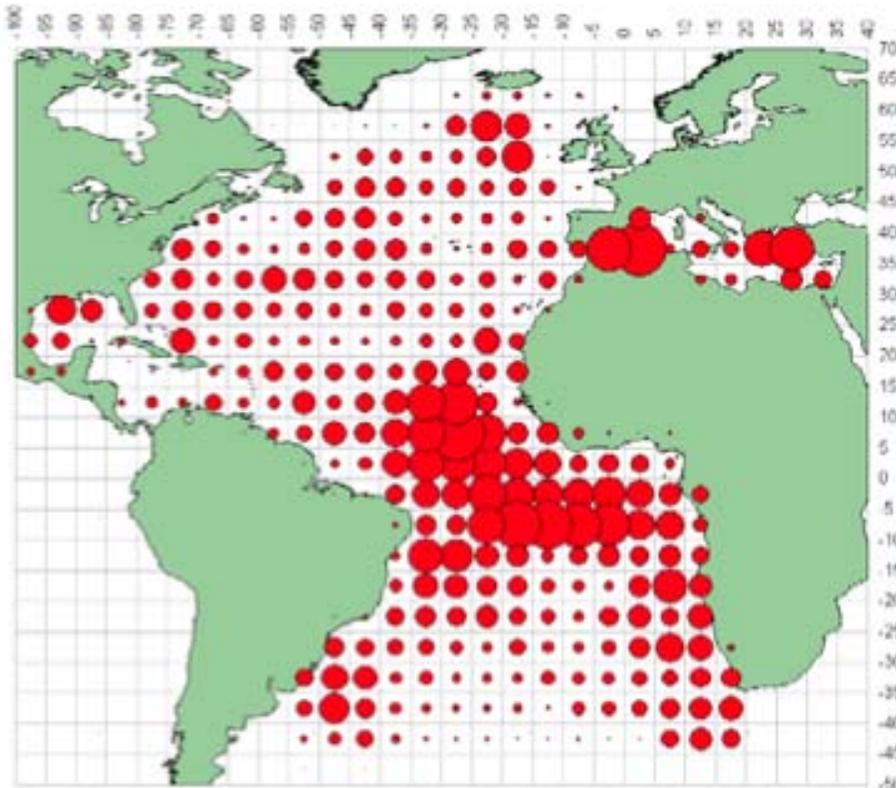
### **b. Indirect Catch**

Commercial fisheries worldwide catch dusky shark indirectly through longline, gillnet, setline and tuna traps (*Id.* at 4-6). Sharks comprise the highest percentage of non-target by-catch in commercial fisheries targeting swordfish and tuna in the Southwest Atlantic (Mandelman et al.

---

<sup>21</sup> Shark meat is also more difficult to process than meat from most fish species because of its high urea content (Morgan 2010 at 1, 4, *citing* Vannuccini 1999).

2008 at 428). Many Latin American countries, Japan, China, Korea, Taiwan, Spain, Cape Verde, the United Kingdom, Bolivia and Barbados all operate PLL vessels in the South Atlantic (Musick et al. 2007 at 5). Commercial fisheries in the Mediterranean also take dusky shark indirectly, using surface longline, trawlers, and artisanal setlines, though fishers often mistake the shark for other grey requiem sharks at fish markets (*Id.*). Fisheries in the Indian Ocean and Australian waters also take the dusky shark as by-catch through PLL (*Id.*). Figure 8 below depicts long-line fishing effort in the North and South Atlantic that effect dusky sharks.



**Figure 8.** Aggregate distribution of hooks deployed by all ICCAT<sup>22</sup> parties 2000-2006. Source: NMFS 2010 at 3-52.

## 2. Recreational Exploitation

As stated above, the U.S. began exploiting dusky sharks through trophy fishing in the 1970s, though recreational dusky shark fishing has generally declined<sup>23</sup> in the NWA/GOM

<sup>22</sup> “ICCAT” is the International Commission for the Conservation of Atlantic Tunas, consisting of 48 parties, which function is “responsibility for the conservation of tunas and tuna-like species in the Atlantic Ocean and adjacent seas,” and which compiles fishery statistics for these species in the Atlantic Ocean, among other things (FAO undated b, entire). PLL fisheries for Atlantic Highly Migratory Species primarily target swordfish and tunas (NMFS 2010 at 3-50). Although Spain, the U.S. and Canada have engaged in PLL fishing in the Atlantic since the late 1950s or early 1960s, the U.S. has decreasingly participated in international HMS longline landings since 1999, while the Japanese PLL tuna fishery, for example, is still very active (*Id.* at 3-51). Most of the 46 other ICCAT nations also operate PLL vessels in the Atlantic (*Id.*).

<sup>23</sup> Although the dusky shark has “prohibited” status, domestic recreational fisheries still land some sharks unintentionally.

region (Musick et al. 2007 at 4-5). Fisheries in Australian and South African waters have historically exploited dusky sharks recreationally and continue to do so (Id. at 5-6). Australians use selective demersal gillnets to target neonates under three years of age, capturing 18-28 percent of the population in its first year (Id. at 5). Off the southern tip of Africa and coast of Madagascar, fishers take dusky shark using recreational line fishing and protective gillnets, and there are beach meshing operations in South Africa that catch juveniles, adolescents, and adults (Id. at 6). Experts have expressed concerns about the high rate of instantaneous fishing mortality in these fisheries, although there is an increasing tendency to release the sharks (Id.).

## **2. Northwest Atlantic/Gulf of Mexico DPS**

### **i. Commercial Exploitation**

There are multiple indicators of negative impacts of commercial fishing on the NWA/GOM DPS, including decreasing temporal trends in mean catch rates and catch size, decreasing biomass, and increasing fishing mortality rates (Cortés et al. 2006 at 50). The stock is heavily exploited by all accounts (Id. at 51-52). As recently as 2011, experts have assessed the dusky shark, over all sensitivities, as “overfished”<sup>24</sup> (SSB2009/SSBMSY of 0.41 to 0.50), with “overfishing”<sup>25</sup> occurring ( $F2009/FMSY$  of 1.39 to 4.35)<sup>26</sup> (SEDAR 2011b at 1).

#### **1. Direct Catch**

Prior to its classification as “prohibited” in 1999,<sup>27</sup> commercial bottom longline fishing targeted the dusky shark from North Carolina to Florida’s west coast, and from Texas to Maine (Cortés et al. 2006 at 7). The average size of dusky sharks declined from the early-mid 1990s to 2003 (Id. at 13, 48). Although U.S. regulations foreclose direct take and retention of dusky shark in U.S. waters, there is evidence that commercial fishers continue to catch dusky shark directly through pelagic and bottom longline fishing (Id.). Furthermore, there is evidence that foreign fleets continue to exploit the dusky shark in U.S. waters (Id. at 51).

---

<sup>24</sup> Scientists consider a stock “overfished” “if the current biomass (B) is less than the minimum stock size threshold ( $B < BMSST$ ). The minimum stock size threshold (MSST) is determined based on the natural mortality of the stock and the biomass at maximum sustainable yield (BMSY). Maximum sustainable yield (MSY) is the maximum long-term average yield that can be produced by a stock on a continuing basis” (NMFS 2010 at 3-41).

<sup>25</sup> Scientists determine that overfishing of a species may be occurring “if the current fishing mortality (F) is greater than the fishing mortality at MSY (FMSY) ( $F > FMSY$ )” (NMFS 2010 at 3-41). In the 2011 analysis of the dusky shark, overfishing was found to occur because the current fishing mortality (for 2009) was 0.055, greater than the fishing mortality at MSY for the dusky (0.035) (SEDAR 2011b at 1).

<sup>26</sup> SSB2009/SSBMSY is a measure of spawning stock biomass in 2009 relative to virgin and  $F2009/FMSY$  is a measure of apical fishing mortality in 2009 relative to virgin (see SEDAR 2011b at 1).

<sup>27</sup> The dusky shark is one of 19 species for which retention is prohibited under the Fishery Management Plan for Atlantic Tunas, Swordfish, and Sharks implemented and amended in 1999 and 2003 respectively (71 Fed. Reg. 30123).

## **2. Indirect Catch**

Biologists agree that incidental take is an important threat to large and coastal sharks in the Northwest Atlantic (Cortés et al. 2006 at 7). In the Gulf of Mexico bottom longline fishery, a sampling of sharks caught incidentally in 2005 included 798 dusky sharks, 304 sandbar sharks, and an additional 1,242 unidentified sharks and rays (Cosandey-Godin and Morgan 2011 at 5, *citing* NMFS 2011a). A Virginia Institute of Marine Science survey concluded that Northwestern Atlantic shark fisheries caused the collapse of the dusky shark population in the region (Baum et al. 2005). The most prevalent commercial fishing gear that fleets use in the Atlantic Ocean is pelagic longline, which catch dusky shark and other sharks as by-catch (Baum et al. 2003 at 389)

### **ii. Recreational Exploitation**

Before the government gave the dusky shark “prohibited” status in 1999, private anglers and charter boats directly targeted the dusky shark, particularly for show in Florida in the 1970s and 1980s, leading to the initial depletion of the NWA/GOM DPS (Cortés et al. 2006 at 7).

## **D. Inadequacy of Existing Regulatory Mechanisms**

### **a. Rangewide**

Federal, state, and/or international laws and policies do not adequately protect the dusky shark to prevent its endangerment. Scientists have found the dusky shark “overfished” with “overfishing occurring” throughout the last decade, and as recently as 2011 (SEDAR 2011b at 1), despite species-specific regulations to recover the dusky. SEDAR scientists predict that the dusky shark will take 100-400 years to recover (SEDAR 2011a at 58). In fact, according to some experts, fisheries have exploited the NWA/GOM DPS of the dusky shark to such an extent that the species would have trouble recovering over the short-term, i.e., in the next twenty years, despite time/area closures, modifications in fishing gear, and reduced catch and discards of the shark (Morgan 2008 at 12).

### **i. Domestic**

As a conservation leader in fisheries management globally, the U.S. is one of only two nations (out of 87 shark-fishing countries) to develop a “National Plan for the Conservation and Management of Sharks” (NOAA undated). The U.S. is also one of the few countries to have steadily instituted management measures for the dusky shark over the years.<sup>28</sup> Nevertheless, the measures have been piecemeal and inadequate, and have failed to mitigate the precipitous decline of the species.

---

<sup>28</sup> The U.S. has been instituting protections for the dusky shark since 1997, when NMFS designated dusky sharks as a “candidate species” for listing under the ESA (62 Fed. Reg. 37560, 37562; Cortés et al. 2006 at 4). However, most protections and research pertain to the NWA/GOM DPS, in contrast to the much more data-deficient Pacific populations (see, e.g., Musick et al. 2007 (all) (providing information about the Atlantic populations, but merely mentioning that Pacific populations exist with no further analysis or information) NOAA undated (saying status of most shark species in the Pacific are unknown)).

In the 1990s, the Magnuson-Stevens Fishery Conservation and Management Act (FCMA) established regional fisheries councils in the U.S., which then developed “fishery management plans” (FMPs) for exclusive economic zones (SEDAR 2001a at 4) designed to rebuild and maintain healthy fish stocks (NOAA undated). In 1999, experts began managing all federal fisheries for sharks under the “Fishery Management Plan for Atlantic Tunas, Swordfish, and Sharks,” later, the “Highly Migratory Species Fishery Management Plan” and their amendments (SEDAR 2001a at 4). The FMPs and their amendments are the core documents from which regulations and policies regarding sharks emanate (Goble and Freyfogle 2010 at 870-871).

NMFS first indicated concern over the depletion of dusky shark populations in 1997, at which time the agency listed the species as a “candidate species” under the ESA (62 Fed. Reg. 37560, 37562). The agency also listed the dusky shark as a “species of concern”<sup>29</sup> the same year in the NWA/GOM and South Atlantic (NOAA 2011 at 3). Neither designation carries substantive or procedural protection under the ESA (69 Fed. Reg. 19975, 19976).

Research for the first HMS FMP in 1999 gave the dusky shark its first practical protection by declaring the species so depleted that NMFS would prohibit any further exploitation, commercially or recreationally, by listing the species as “prohibited”<sup>30</sup> (Roberts 2005 at 37). However, prohibited status has failed to mitigate the dusky shark’s decline, given extremely high mortality rates in contrast to those of other sharks, and misidentification issues<sup>31</sup> (*Id.* at 38). In addition, overfishing is still occurring for several of the federally prohibited species, including the dusky shark, often in state waters, where retention is still permitted (*Id.* at 37).

In 2005, NMFS instituted a time/area closure for dusky shark nursery and pupping areas off the North Carolina coast from January to July to reduce depletion of the species from by-catch and juvenile/neonate mortality (SEDAR 2011a at 7). The closure and others like it have proven to increase shark densities over relatively short periods of time<sup>32</sup> (Morgan 2008 at 93). However, a 2009 stock assessment of the dusky shark confirmed that the species was still subject to “overfishing” and was still “overfished” (NOAA 2010 at 4). In 2008, NMFS implemented several management measures consistent with the 2006 dusky shark stock assessment, but they were not specific to the dusky shark and failed to include specific, enforceable measures for rebuilding dusky populations.<sup>33</sup>

---

<sup>29</sup> NMFS uses “species of concern” to “identify species about which NMFS has some concerns regarding status and threats, but for which insufficient information is available to indicate a need to list the species under the ESA” (69 Fed. Reg. 19975, 19976). Like “candidate species,” species of concern designations carry no statutory protection under the ESA (*Id.*).

<sup>30</sup> See note 17 for “prohibited” status. All fishers, commercial and recreational, are prohibited from keeping 19 species of sharks, including the dusky shark.

<sup>31</sup> One study found 79 percent of smaller dusky sharks caught on pelagic longlines dead when hauled in, compared to 37 percent with larger sharks (Roberts 2005 at 38, *citing* NMFS 2003).

<sup>32</sup> Researchers discovered six-to-ten times the number of juvenile dusky sharks in two closed nursery areas versus that of the other open areas (Morgan 2008 at 93). Tagging and telemetry data from inside and outside one marine protected area have also shown that shark abundance and activity is greatest along the coastline least disturbed by human activity (Cosandey-Godin and Morgan 2011 at 8, *citing* Garla et al. 2005).

<sup>33</sup> The 2008 management measures were not specific for the dusky but included rebuilding plans for “porbeagle, dusky and sandbar sharks consistent with stock assessments.” (SEDAR 2011a at 8, *citing* 73 Fed. Reg. 35778; corrected version published July 15, 2008; 73 Fed. Reg. 40658).

Researchers have reassessed the dusky shark's population status as recently as July 2010 and August 2011 and expressed urgent concern over the species. In April of 2008, NMFS reduced the Total Allowable Catch for the directed large coastal non-sandbar shark fisheries, crucial to reducing by-catch of the dusky shark (Morgan 2008 at 16, 124, *citing* NMFS 2008). Additionally, the agency updated essential fish habitat (EFH)<sup>34</sup> identifications for dusky sharks, among others (74 Fed. Reg. 28018, 28020). However, as NOAA has admitted, EFH is an advisory and unenforceable designation, unless a federal permit is involved (NMFS 2007 at 4).

Finally, the U.S. has taken some action on issues that are ancillary to dusky shark conservation, e.g., management of fisheries that capture dusky indirectly as by-catch, which has done little to adequately protect the species. The Shark and Fishery Conservation Act became law in January 2011, which implemented a ban on shark finning, prohibiting any person under U.S. jurisdiction from engaging in shark finning and possessing shark fins harvested on board a U.S. fishing vessel without the corresponding carcasses (Shark and Fishery Conservation Act, Pub. L. No. 111-348, §§ 102, 103, 124 Stat. 3668 (2011); Kelm 2011 at 2-3). The act requires NMFS to promulgate regulations to implement its prohibitions, "initiate discussion with other nations to develop international agreements on shark finning and data collection, provide [C]ongress with annual reports describing efforts to carry out the Act and establish research programs" (NMFS undated at 1). But there is no evidence that this act will mitigate the decline of the dusky shark because of the high rates of mortality associated with dusky haul and misidentification problems. The act also does not mitigate incidental take or finning at docks (Tutchton, pers. comm., June 2010).

## **1. Commercial Exploitation**

As stated above, the dusky shark was designated as "prohibited" for capture since 1999, and is therefore free from undulating restrictions through quotas, trip limits, and limited access permits (NMFS 2011b). But the 2006 and 2011 dusky shark stock assessments continue to show a decline in the species from commercial fishing (Cortés et al. 2006 at 48; SEDAR 2011a at 38-39).

### **a. Direct Catch**

Prohibited status and by-catch recommendations have not prevented fishers from catching the dusky shark in several state fisheries (Morgan 2008 at 16).

### **b. Indirect Catch**

"Prohibited" status has also not mitigated the effect of by-catch on the dusky shark in domestic shark fisheries (Morgan 2008 at 16, 17). Although quantifying total shark mortality from by-catch is challenging due to a lack of comprehensive data on discards (*Id.* at 2), despite

---

<sup>34</sup> "Essential fish habitat (EFH)" is "those waters and substrate necessary to fish spawning, breeding, feeding, or growth to maturity." (16 U.S.C. Section 1853(a)(7)) The FCMA requires fishery management plans (FMPs) to "describe and identify essential fish habitat for the fishery." (*Id.* at Section 1802(10))

widespread recognition of its significant role in shark mortality, policymakers have adopted few measures to address the problem (Cosandey-Godin and Morgan 2011 at 3).

Provisions relevant to NMFS' management of shark by-catch include FCMA standards, by-catch and observer workshops, and hook and bait restrictions (50 C.F.R. § 600.350; NMFS 2005 at 5, 7, 10, 12). By-catch recommendations relate to class of shark (e.g. "prohibited" or LCS) and gear type. The 3rd Amended HMS FMP was supposed to have reduced by-catch by PLL, but there is no evidence of reductions (Morgan 2010 at 4, *citing* Clarke et al. 2007; Clarke et al. 2004).

## **2. Recreational Exploitation**

"Prohibited" status also restricts recreational fishers from selling, possessing or taking dusky shark (16 U.S.C. § 1801; NMFS 2011b). Although recreational fishing for dusky shark and other sharks has decreased domestically compared to 1970s and 1980s rates, recreational fishing is still a threat to the species because of long soak times<sup>35</sup> experienced by dusky sharks caught as by-catch in recreational fisheries (Morgan 2008 at 55).

### **ii. International**

The U.S. has taken the lead in shark management globally in helping develop the FAO's International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks), but the conservation measures are only voluntary (Lack and Sant 2008 at 30). Only a few nations have a management plan for sharks and only the U.S. has a management plan for the dusky shark, though it is not specific to the species.<sup>36</sup> Individual countries such as Australia have made minor adjustments to their dusky shark quotas in the wake of depletions, but there is no evidence that these management measures have staved off decline of individual populations (Musick et al. 2007 at 2, 6; NOAA 2010 at 48). Fisheries around the world generally continue to deplete dusky shark populations directly and indirectly, driven by international markets for shark meat and fins, and there is no evidence that these trends are abating (NOAA 2010 at 48).

The Carcharhinidae family is "protected" under the 1995 UN Agreement on the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks,<sup>37</sup> but states have made little progress under this United Nations Convention on the Law of the Sea Agreement (Musick et al. 2009 at 9).

The Convention on International Trade in Endangered Species (CITES) has the potential to mitigate threats to the dusky shark through restrictions on trade in animal species and their parts. (Convention on International Trade in Endangered Species of Wild Fauna and Flora, Jul. 1, 1975, 27 U.S.T. 1087, 993 U.N.T.S. 243; CITES 2010a at 1 (considering adding dusky shark to protection under Appendix II of CITES)) But several parties to CITES withdrew the U.S.

---

<sup>35</sup> Soak time is "the interval between the time the first hook entered the water until the first hook was removed from the water" (Morgan and Burgess 2007 at 2).

<sup>36</sup> See note 33.

<sup>37</sup> 1995 UN Agreement on the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish, December 11, 2001; Musick et al. 2009 at 9 ("[t]he agreement specifically requires coastal and fishing states to cooperate and adopt measures to ensure the conservation of listed species.").

proposal in March of 2010 to list the dusky shark under Appendix II before the end of the COP<sup>38</sup> (CITES 2010b at 1). Consequently, jurisdictions outside the U.S. will continue to trade in the dusky shark as both a direct and indirect target of commercial and recreational fishing almost completely free of regulation and enforcement. The fact that countries rejected CITES listings for the dusky shark at the last conference of the parties (Id.) makes ESA-listing of the dusky shark that much more urgent.

**Table 2. Biological statuses for the dusky shark as determined by IUCN and experts.**

Range	International biological statuses	Laws and policies
Rangewide	“Vulnerable”; “facing a high risk of extinction in the wild” (Musick et al. 2007; IUCN 2001)	n/a
Northwest Atlantic/Gulf of Mexico	IUCN - “Endangered” (i.e. “a very high risk of extinction in the wild”) (Musick et al. 2007; IUCN 2001)	U.S.: See DPS Section below. Mexico: No dusky shark management (CITES 2010c at 15; Hoffmayer et al. 2010 at 4)
Eastern Pacific	Not assessed, likely Data Deficient (Musick et al. 2007; IUCN 2001)	n/a
Southwest Atlantic	“Near threatened” (Musick et al. 2007; IUCN 2001)	n/a
Mediterranean Sea	Not assessed, likely Data Deficient (Musick et al. 2007; IUCN 2001)	n/a
Indian Ocean	Not assessed, likely Data Deficient (Musick et al. 2007; IUCN 2001)	n/a

<sup>38</sup>A CITES Appendix II listing would have had the potential to actually mitigate threats to the dusky shark through restrictions on trade in animal species and their parts (CITES 2010a at 1). Member states submitted a proposal to list the dusky shark under Appendix II, Annex 2B, Criterion A (together with three other sharks), because fisheries commonly confuse the fins of the dusky shark with the “look-alike” fins of the scalloped hammerhead shark (Id. at 1, 3, 24-25). Parties withdrew the proposal for the dusky in order to agree to vote for other look-alike sharks (Susan Lieberman, pers. comm., Nov. 2011).

Range	International biological statuses	Laws and policies
Australia (Indian Ocean, Coral Sea, Tasman Sea)	“Near threatened” (Musick et al. 2007; IUCN 2001)	Australia: In the development of a CITES Shark Species of Concern list in 2010, Australia agreed with prioritization of hammerheads as a group, as well as sandbar, dusky, and oceanic whitetip sharks; authorities have also implemented species-specific management regulations to prohibit take of older dusky sharks (CITES 2010c at 13-14)

## 1. Commercial Regulation

The only relevant international regulation of commercial fishing for dusky shark pertain to monitoring and finning. No regional fishery management organizations (RFMOs) or international organizations that manage high seas fishing, including ICCAT, have developed management plans for sharks or set catch limits (Cosandey-Godin and Morgan 2011 at 8). ICCAT and IATTC (Inter-American-Tropical-Tuna Commission) have adopted finning bans, as have Canada, the U.S., the EU, Australia, and Brazil (WWF 2005 at 1-2). Finning regulations are generally inadequate for protecting the dusky shark because they do not protect the dusky shark from capture, directly or indirectly, and finning contributes to a very high mortality rate for this species (Cortés et al. 2006 at 28).

The value of shark fins has increased concurrent with economic growth in China in recent years, finning is now a major factor in the commercial exploitation of sharks worldwide, and there are few signs this demand is subsiding (Morgan 2010 at 4, citing others). Researchers have recognized a number of other human benefits from shark parts, including shark cartilage and liver oil for combating cancer and bacterial, viral, and fungal infections, as well as fertilizers (Id.). These uses may put additional pressure on dusky shark populations.

### a. Direct Catch

To date, two RFOs, ICCAT and IATTC, have adopted finning bans, *infra*, as have several range states. Only Canada and the U.S. have shark management plans, but the species is extremely rare in Canadian waters (CITES 2010b at 14). Australian laws include new limits on severely depleted populations of dusky shark and fairly restrictive management measures, but do not protect the shark outright (Id. at 13).

### b. Indirect Catch

As described in Factor B above, international take through by-catch is a leading cause of decline of dusky shark populations globally and is unregulated apart from finning measures, mentioned

above. The lack of international reporting requirements also exacerbates the paucity of international regulation of by-catch: FAO maintains only landing records (i.e., accounts of fishermen offloading a shark from one location to another) and does not maintain data on sharks that are “unrecorded, recorded in non-shark categories or discarded at sea” (Clarke et al. 2006b at 1120-22).

## 2. Recreational Regulation

There are no relevant international regulations on recreational fishing for dusky shark rangewide.

### b. Northwest Atlantic/Gulf of Mexico DPS

Dusky sharks are a “prohibited” species under the HMS FMP off the U.S. Atlantic coast.<sup>39</sup> Amendments to the HMS FMP also recommend new management measures for different classes of sharks and for the dusky shark in particular, every few years.<sup>40</sup> Although some experts believe these measures have contributed to increased recruitment, they also believe high by-catch mortality might be limiting the extent to which the recruits survive to maturity (Musick et al. 2007). The 2002 large coastal shark assessment indicated that prohibited species are particularly vulnerable to overfishing due to their low population growth rates (Cortés et al. 2006 at 6). A recent demographic analysis of dusky sharks from the Northwest Atlantic reported that population levels would decline at even low levels of fishing, making this species one of the most vulnerable to excessive fishing mortality, and suggesting that stringent regulatory measures are required for populations to reach recovery levels (Hoffmayer et al. 2010 at 2).

In 2005, NMFS also instituted a time/area closure for the shark nurseries and pupping areas off North Carolina from January to July to reduce neonate and juvenile mortality (NMFS 2010 at 9-4). The time/area closure has forced commercial shark fishers to seek out other fisheries or other gear to target sharks and other species (*Id.*).<sup>41</sup> Nevertheless, research indicates that time/area closures, gear modifications, and/or catch and discard reductions in Atlantic/GOM waters over the next twenty years would likely fail to compensate for current fishing impacts on the dusky shark (Morgan 2008 at 52).

State laws (in the following table) also govern management of the NWA/GOM DPS but have been insufficient to stem mitigation of the dusky’s decline.

---

<sup>39</sup> See Section IV. A. 1.

<sup>40</sup> See Section IV. A. 1.

<sup>41</sup> Many fishers claim that the closure has hurt their businesses (NMFS 2010 at 9-4). However, participation in commercial fishing, in general, in these areas has declined due to hiring and managing difficulties and due to high turnover in crews as vessels shift to other fisheries and/or revenues drop (*Id.*)

**Table 3. Relevant state laws affecting dusky shark in the Northwest Atlantic/Gulf of Mexico (current as of January 1, 2010).**

State	Relevant laws
Delaware	Prohibited species: same as federal - prohibition against fins not naturally attached to body (NMFS 2010 at 3-9, <i>citing</i> DE Code Regulations 3541)
Maryland	Adopted into regulation all measures for the ASMFC Interstate Fishery Management Plan for Atlantic Coastal Sharks ( <i>Id.</i> at 3-9, <i>citing</i> Code of Maryland Regulations 08.02.12.03 and 08.02.22.01-.04)
Virginia	Bag limits on large coastal sharks; prohibitions - fillet at sea, long-lining, same prohibited species as federal regulations ( <i>Id.</i> at 3-9, <i>citing</i> 4 VA Administrative Code 20-490)
North Carolina	Director may impose restrictions for size, season, areas, quantity, etc. (January-July dusky and sandbar closure); LCS restrictions; same prohibited species as federal regulations ( <i>Id.</i> at 3-10, <i>citing</i> NC Administrative Code tit. 15A, r.3M.0505)
South Carolina	Prohibition on gillnets; reference to commercial federal regulations and prohibited species ( <i>Id.</i> at 3-10, <i>citing</i> SC Code Ann. 50-5-2730)
Georgia	Dusky sharks are prohibited species; all sharks must be landed with head and fins intact; prohibition on longlines and gillnets in state waters ( <i>Id.</i> at 3-10, <i>citing</i> GA Code Ann. ' 27-4-130.1; OCGA ' 27-4-7(b); GA Comp. R. & Regs. ' 391-2-4-.04)
Florida	Prohibited species: same as federal regulations ( <i>Id.</i> at 3-10, <i>citing</i> FL Administrative Code Ann. r.68B-44, F.A.C)
Alabama	Dusky sharks are prohibited species ( <i>Id.</i> at 3-10, <i>citing</i> AL Administrative Code r. 220-2- .46, r.220-3-.30, r.220-3-.37)
Louisiana	Prohibited species: same as federal regulations ( <i>Id.</i> at 3-10, <i>citing</i> LA Administrative Code Title 76, Pt. VII, Ch. 3, § 357)
Mississippi	Prohibited species: reference to federal regulations ( <i>Id.</i> at 3-10, <i>citing</i> MS Code Title-22 part 7)
Texas	Prohibited species: same as federal regulations ( <i>Id.</i> at 3-10, <i>citing</i> TX Administrative Code Title 31, Part 2, Parks and Wildlife Code Title 5, Parks and Wildlife Proclamations 65.3 and 65.72)

## **E. Other Natural or Manmade Factors**

**Biological Vulnerability.** As discussed above, dusky sharks grow more slowly (less than 4 percent a year), mature later (19-21 years on average) and have a shorter reproductive cycle (every three years) than most other sharks (Natanson et al. 1995 at 119; NOAA 1998 at 133). The dusky shark's inherently slow growth rate makes the species particularly vulnerable to overfishing (Cortés et al. 2006 at 6) and ensures very slow recovery, even without fishing (Roberts 2005 at 38). Recruitment is also directly related to stock size in the dusky shark (Cortés et al. 2006 at 20). Because scientists have also determined that the juvenile segments of the population, rather than adult survival or fertility, contribute the most to the species' population growth, management of dusky shark juveniles is particularly critical (Id.; Camhi et al. 1998 at 5). But, apart from the North Carolina shark fishing time/area closure, there is no juvenile-specific protection for the dusky shark.

**Ecological Vulnerability.** The dusky shark's preferred habitat also makes the species ecologically vulnerable to population decline. Despite large home ranges (Hoffmayer et al. 2010 at 4), researchers have determined that mother dusky sharks occupy the same region generation after generation, which makes them particularly vulnerable to overfishing (Wall 2011 at 2-3). The species geographic preferences also affect the ability of dusky sharks in some areas to sustain their populations (Id.).

**Misidentification.** Visual identification of the dusky shark has compounded management problems because the fins of the species can be easily mistaken for those of the scalloped hammerhead or other non-prohibited large coastal sharks, rendering the dusky particularly vulnerable to illicit finning and fatality through by-catch (SSN 2010 at 2).

**Cumulative Impacts.** Pollution, such as the Deepwater Horizon oil spill, compound the dusky shark's inherent biological and ecological vulnerability, and result in a growth rate that may lead to a population collapse (Romine et al. 2009 at 287).

## **REQUESTED DESIGNATION**

WildEarth Guardians hereby petitions the U.S. Department of Commerce, National Marine Fisheries Service to list the dusky shark (*Carcharhinus obscurus*) rangewide and/or the Northwest Atlantic/Gulf of Mexico population as a distinct population segment under the Endangered Species Act. Listing is warranted, given the formidable threats facing the species and its long-term population declines. The dusky shark is threatened by at least four listing factors in the ESA: overutilization; the present modification of the dusky shark's habitat in the Gulf of Mexico; inadequate existing regulatory mechanisms; and other natural or manmade factors affecting its continued existence. ESA listing will help conserve and recover the dusky shark and its habitat.

## **CRITICAL HABITAT**

WildEarth Guardians requests that critical habitat be designated for this species concurrent with final ESA listing.

## REFERENCES

62 Fed. Reg. 37560 (July 14, 1997).

69 Fed. Reg. 19975 (April 15, 2004).

71 Fed. Reg. 30123 (May 25, 2006).

71 Fed. Reg. 61022 (October 17, 2006).

73 Fed. Reg. 40658 (July 15, 2008).

74 Fed. Reg. 28018 (June 12, 2009).

Baum, J., P. Doherty, S. Harley, D. Kehler, R. Myers, and B. Worm. 2003. Collapse and conservation of shark populations in the Northwest Atlantic. *Science* 299: 389-392.

Baum, J., D. Kehler, and R. Myers. 2005. Robust estimates for decline for pelagic shark populations in the northwest Atlantic and Gulf of Mexico. *Fisheries* 30: 10, 27-29, 29.

Baum, J., and R. Myers. 2004. Shifting baselines and the decline of pelagic sharks in the Gulf of Mexico. *Ecology Letters* 7: 135-145.

Brothers, N., J. Cooper, and S. Lokkeborg. 1999. The incidental catch of seabirds in longline fisheries: Worldwide review and technical guidelines for mitigation. FAO Fisheries Circular No. 937.

Camhi, M., S. Fowler, J. Musick, A. Bräutigam, and S. Fordham. 1998. Sharks and their relatives: ecology and conservation. Occasional Paper of the IUCN Species Survival Commission No. 20. IUCN/SSC Shark Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK.

Camhi, M., J. Musick, and C. Simpfendorfer. 2000. *Carcharhinus obscurus* (Northwest and Western Central Atlantic subpopulation). In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.1. Available at: [www.iucnredlist.org](http://www.iucnredlist.org).

Center for Biological Diversity [CBD]. Undated. Gulf Disaster: Habitats and Species Affected. Available at [www.biologicaldiversity.org/programs/public\\_lands/energy/dirty\\_energy\\_development/oil\\_and\\_gas/gulf\\_oil\\_spill/habitats\\_and\\_species.html](http://www.biologicaldiversity.org/programs/public_lands/energy/dirty_energy_development/oil_and_gas/gulf_oil_spill/habitats_and_species.html).

Clarke, S. 2004. Understanding pressures on fishery resources through trade statistics: a pilot study of four products in the Chinese dried seafood market. *Fish and Fisheries*, 5, 53-74.

Clarke, S., J. Magnussen, D. Abercrombie, M. McAllister, M. Shivji [Clarke et al. 2006a]. 2006. Identification of Shark Species Composition and Proportion in the Hong Kong Shark Fin Market Based on Molecular Genetics and Trade Records. *Conservation Biology* vol. 20, No. 1, 201-211.

Clarke, S., M. McAllister, E. Milner-Gulland, G. Kirkwood, C. Michielsens, D. Agnew, E. Pikitch, H. Nakano, M. Shivji [Clarke et al. 2006b]. 2006. Global estimates of shark catches using trade records from commercial markets. *Ecology Letter* 9: 1115-1126.

Clarke, S., E. Milner-Gulland, T. Bjørndal, C. Emere. 2007. Social, economic, and regulatory drivers of the shark fin trade. *Marine Resource Economics* 22: 305-327.

Convention of International Trade in Endangered Species of Wild Fauna and Flora [CITES 2010a]. 2010. CoP15 Prop. 15. Consideration of Proposals for Amendment of Appendices I and II: Inclusion of *Sphyrna lewini* (scalloped hammerhead shark) in Appendix II in accordance with Article II paragraph 2(a) of the Convention &c. Fifteenth meeting of the Conference of the Parties, Doha (Qatar), 13-25 March.

Convention of International Trade in Endangered Species of Wild Fauna and Flora [CITES 2010b]. 2010. CoP15 Com. I Rec. 13 (Rev. 2). Summary Record of the 13th Session of Committee I. Fifteenth meeting of the Conference of the Parties, Doha (Qatar), 13-25 March.

Convention of International Trade in Endangered Species of Wild Fauna and Flora [CITES 2010c]. 2010. Consideration of Proposals for Amendment of Appendices I and II: Inclusion of *Lamna nasus* (Bonnaterre, 1788) in Appendix II in accordance with Article II 2(a) and (b). Fifteenth meeting of the Conference of the Parties, Doha (Qatar), 13-25 March.

Cortés, E., E. Brooks, P. Apostolaki, C. A. Brown. 2006. Stock Assessment of Dusky Shark in U.S. Atlantic and Gulf of Mexico. NMFS Panama City Laboratory, Sustainable Fisheries Division Contribution SFD-2006-014.

Cosandey-Godin, A., and A. Morgan. 2011. Fisheries Bycatch of Sharks: Options for Mitigation. Ocean Science Division, Pew Environment Group: Washington, DC.

Drapkin, J. 2010. 10 Animals Most At Risk from Gulf Oil Spill. CBS News World Watch. Available at: [www.cbsnews.com/8301-503543\\_162-20003738-503543.html](http://www.cbsnews.com/8301-503543_162-20003738-503543.html).

Dudley, S., G. Cliff, M. Zungu, M. Smale. 2005. Sharks caught in the protective gill nets off KwaZulu-Natal, South Africa. 10. The dusky shark *Carcharhinus obscurus*. *African J. Marine Sci* 27(1): 107-127.

Dulvy, N., J. Baum, S. Clarke, L. Compagno, E. Cortés, A. Domingo, S. Fordham, S. Fowler, M. Francis, C. Gibson, J. Martínez, J. Musick, A. Soldo, J. Stevens, and S. Valenti. 2008. You can swim but you can't hide: the global status and conservation of oceanic pelagic sharks and rays. *Aquatic Conservation: Marine and Freshwater Ecosystems* 18: 459-482.

Ebert, D. A. 2003. SHARKS, RAYS, AND CHIMAERAS OF CALIFORNIA. University of California Press.

Florida Museum of Natural History [FLMNH]. Undated. Field Key to Sharks of North Carolina and Adjacent Waters: Dusky Shark. Florida Museum of Natural History Ichthyology Department. Available at: [www.flmnh.ufl.edu/fish/Education/sharkkey/duskyshark.html](http://www.flmnh.ufl.edu/fish/Education/sharkkey/duskyshark.html).

Food and Agriculture Organization of the United Nations [FAO]. 2010. Report of the technical consultation to develop international guidelines on bycatch management and reduction of discards. FAO Fisheries and Aquaculture Report.

Food and Agriculture Organization of the United Nations [FAO]. 2012. Species Fact Sheet: *Carcharhinus obscurus*. Available at: [www.fao.org/fishery/species/2811/en](http://www.fao.org/fishery/species/2811/en).

Food and Agriculture Organization of the United Nations [FAO undated a]. Undated. Guidelines for the Routine Collection of Capture Fishery Data. Annex 5. Glossary.

Food and Agriculture Organization of the United Nations [FAO undated b]. Undated. Regional fisheries bodies fact sheets: International Commission for the Conservation of Atlantic Tunas. Available at: [www.fao.org/fishery/rfb/iccat/en#Org-Mission](http://www.fao.org/fishery/rfb/iccat/en#Org-Mission).

Food and Agriculture Organization of the United Nations [FAO undated c]. Undated. Selectivity of Gear. Available at: [www.fao.org/fishery/topic/12282/en](http://www.fao.org/fishery/topic/12282/en).

Garla, R., D. Chapman, B. Wetherbee, M. Shivji. 2005. Movement patterns of young Caribbean reef sharks, *Carcharhinus perezi*, at Fernando de Noronha Archipelago, Brazil: The potential of marine protected areas for conservation of a nursery ground. *Marine Biology* 149: 189-199.

Goble, D., and E. Freyfogle. 2010. WILDLIFE LAW: CASES AND MATERIALS. 2nd Ed. Foundation Press. (pages 870-71).

Griffin, E., K. Miller, B. Freitas, and M. Hirshfield. 2008. Predators as Prey: Why Healthy Oceans Need Sharks. Oceana: Washington DC.

Handwerk, B. 2010. Whale Sharks Killed, Displaced by Gulf Oil? National Geographic Daily News, Sept. 24. Available at: [news.nationalgeographic.com/news/2010/09/100924-whale-sharks-gulf-oil-spill-science-environment](http://news.nationalgeographic.com/news/2010/09/100924-whale-sharks-gulf-oil-spill-science-environment).

Hoch, M. 2010. New Estimate Puts Gulf Oil Leak at 205 Million Gallons. Available at: [www.pbs.org/newshour/rundown/2010/08/new-estimate-puts-oil-leak-at-49-million-barrels.html](http://www.pbs.org/newshour/rundown/2010/08/new-estimate-puts-oil-leak-at-49-million-barrels.html).

Hoffmayer, E., J. Franks, W. Driggers, and M. Grace. 2010. Movements and Environmental Preferences of Dusky Sharks, *Carcharhinus obscurus*, in the Northern Gulf of Mexico. SEDAR21-DW-37. Southeast Data, Assessment, and Review: North Charleston, SC. Available at: [www.sefsc.noaa.gov/sedar/Sedar\\_Documents.jsp?WorkshopNum=21&FolderType=Data](http://www.sefsc.noaa.gov/sedar/Sedar_Documents.jsp?WorkshopNum=21&FolderType=Data).

Hovgard, H. and H. Lassen. 2000. Manual on estimation of selectivity for gillnet and longline gears in abundance surveys. FAO Fisheries Technical Paper No. 397.

Hueter, R. and J. Gelsleichter. 2010. Effects of the Deepwater Horizon Oil spill on epipelagic and large coastal sharks of the Gulf of Mexico. Principal Investigator Workshop Presentation. The Florida Institute of Oceanography: St. Petersburg, FL, September 15-16. Available at:  
[www.fio.usf.edu/Research/BPFundedProjects/PIWorkshopPresentations.aspx](http://www.fio.usf.edu/Research/BPFundedProjects/PIWorkshopPresentations.aspx).

International Commission for the Conservation of Atlantic Tunas [ICCAT]. Undated. Available at [www.iccat.es/en](http://www.iccat.es/en).

International Union for the Conservation of Nature [IUCN]. 2001. IUCN Red List Categories and Criteria: Version 3.1. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.

Kelm, B. 2011. Shark Conservation Act Becomes Law. Available at:  
<http://www.wired.com/wiredscience/2011/01/shark-conservation-act>.

Knickle, C. Undated. Biological Profile: Dusky Shark. Florida Museum of Natural History Ichthyology Department. Available at:  
[www.flmnh.ufl.edu/fish/gallery/descript/duskyshark/duskyshark.html](http://www.flmnh.ufl.edu/fish/gallery/descript/duskyshark/duskyshark.html).

Lack, M., and G. Sant. 2008. Illegal, unreported and unregulated shark catch: A review of current knowledge and action. Department of the Environment, Water, Heritage and the Arts and TRAFFIC, Canberra.

Mandelman, J., P. Cooper, T. Werner, K. Laguex. 2008. Shark bycatch and depredation in the U.S. atlantic pelagic longline fishery. *Rev. Fish Biol. Fisheries* 18: 427-442.

McAuley, R., X. Simpfendorfer, X. Hall. 2007. A method for evaluating the impacts of fishing mortality and stochastic influences on the demography of two long lived shark stocks. *ICES J. Marine Sci.* 64: 1710-1722.

Morgan, A. and G. Burgess. 2007. At-Vessel Fishing Mortality for Six Species of Sharks Caught in the Northwest Atlantic and Gulf of Mexico. *Gulf and Caribbean Research* Vol 19(2).

Morgan, A. 2008. Effects of temporal closures and gear modifications on the population of dusky sharks in the Northwestern Atlantic Ocean. Ph.D. Dissertation. University of Florida: Gainesville, FL.

Morgan, A. 2010. *Sharks: The State of the Science*. Ocean Science Division, Pew Environment Group: Washington, DC.

Musick, J., R. Grubbs, J. Baum, and E. Cortés. 2007. *Carcharhinus obscurus*. In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.1.

Musick, J., R. Grubbs, J. Baum, E. Cortés, J. Stevens, S. Dudley, D. Pollard, A. Sado. 2009. *Carcharhinus obscurus*. Available at: <http://www.iucnredlist.org/details/3852/0/print>.

Myers, R., J. Baum, T. Shepherd, S. Powers, and C. Peterson. 2007. Cascading effects of the loss of apex predatory sharks from a coastal ocean. *Science* 315: 1846-1850.

Natanson, L., J. Casey, N. Kohler. 1995. Age and growth estimates for the dusky shark, *Carcharhinus obscurus*, in the western North Atlantic Ocean. *Fishery Bulletin* 93: 116-126.

National Marine Fisheries Service [NMFS]. 2003. Stock Assessment and Fishery Evaluation (SAFE) Report for Atlantic Highly Migratory Species. Available at: [http://www.nmfs.noaa.gov/sfa/hms/Safe\\_Report/2003/2003\\_SAFE\\_Final.pdf](http://www.nmfs.noaa.gov/sfa/hms/Safe_Report/2003/2003_SAFE_Final.pdf).

National Marine Fisheries Service [NMFS]. 2005. Highly Migratory Species Current Bycatch Priorities and Implementation Plan (working document). Available at: [http://www.nmfs.noaa.gov/by\\_catch/HMSfinal\\_bycatchplan.pdf](http://www.nmfs.noaa.gov/by_catch/HMSfinal_bycatchplan.pdf).

National Marine Fisheries Service [NMFS]. 2007. Essential fish habitat and critical habitat: A comparison. Available at: <http://www.habitat.noaa.gov/media/publications.html>.

National Marine Fisheries Service [NMFS]. 2008. Final amendment 2 to the consolidated Atlantic highly migratory species Fishery Management Plan. Available at: [http://www.nmfs.noaa.gov/sfa/hms/FMP/AM2\\_FEIS/Total.pdf](http://www.nmfs.noaa.gov/sfa/hms/FMP/AM2_FEIS/Total.pdf).

National Marine Fisheries Service [NMFS]. 2009. Stock Assessment and Fishery Evaluation (SAFE) Report for Atlantic Highly Migratory Species. Available at: [http://www.nmfs.noaa.gov/sfa/hms/Safe\\_Report/2009/HMS\\_SAFE\\_Report\\_2009\\_FINAL\\_FULL\\_DOCUMENT.pdf](http://www.nmfs.noaa.gov/sfa/hms/Safe_Report/2009/HMS_SAFE_Report_2009_FINAL_FULL_DOCUMENT.pdf).

National Marine Fisheries Service [NMFS]. 2010. Final Amendment 3 to the Consolidated Atlantic Highly Migratory Species Fishery Management Plan. Office of Sustainable Fisheries, Highly Migratory Species Management Division: Silver Spring, MD.

National Marine Fisheries Service [NMFS 2011a]. 2011. Proactive Conservation Program: Species of Concern. Available at [www.nmfs.noaa.gov/pr/species/concern](http://www.nmfs.noaa.gov/pr/species/concern).

National Marine Fisheries Service [NMFS 2011b]. 2011. Highly Migratory Species Commercial Compliance Guide: Guide for Complying with the Atlantic Tunas, Swordfish, Sharks, and Billfish Regulations. Office of Sustainable Fisheries, Highly Migratory Species Management Division: Silver Spring, MD.

NMFS. Undated. Annual Report to Congress Pursuant to the Shark Finning Prohibition Act. Available at: [http://www.nmfs.noaa.gov/sfa/domes\\_fish/news\\_of\\_note.htm](http://www.nmfs.noaa.gov/sfa/domes_fish/news_of_note.htm).

National Oceanic and Atmospheric Administration [NOAA]. 1998. Endangered Species Act Biennial Report to Congress: October 1, 1996 - September 30, 1998. Office of Protected Resources: Silver Spring, MD.

National Oceanic and Atmospheric Administration [NOAA]. 2006. Fisheries Glossary.

National Oceanic and Atmospheric Administration [NOAA]. 2010. 2010 Shark Finning Report to Congress. Pursuant to the Shark Finning Prohibition Act of 2000 Public Law 106-557.

National Oceanic and Atmospheric Administration [NOAA]. Undated. Shark Management. NOAA Fisheries Fact Sheet. Available at [www.nmfs.noaa.gov/sharks/FS\\_management.htm](http://www.nmfs.noaa.gov/sharks/FS_management.htm).

Peterson, C., F. Coleman, J. Jackson, R. Turner, G. Rowe, R. Barber, K. Bjorndal, R. Carney, R. Cowen, J. Hoekstra, J. Hollibaugh, S. Laska, R. Luettich Jr., C. Osenberg, S. Roady, S. Senner, J. Teal, and P. Wang. 2011. A Once and Future Gulf of Mexico Ecosystem: Restoration Recommendations of an Expert Working Group. Pew Environment Group: Washington, DC.

Pew Environment Group [Pew 2011a]. 2011. Gulf Surface Longline Campaign. Sharks in the Gulf of Mexico: The Facts. Factsheet produced by the Pew Environment Group: Washington, DC.

Pew Environment Group [Pew 2011b]. 2011. Sharks in Trouble: Hunters become the Hunted. Pew Environment Group: Washington, DC.

Roberts, S, 2005. Seafood Watch Seafood Report - Sharks and Dogfish (with a stock status update from 2010). Monterey Bay Aquarium: Monterey, CA.

Romine, J., J. Musick, G. Burgess. 2009. Demographic analyses of the dusky shark, *Carcharhinus obscurus*, in the Northwest Atlantic incorporating hooking mortality estimates and revised reproductive parameters. *Environ. Biol. Fish* 84: 277-289.

Shark and Fishery Conservation Act, Pub. L. No. 111-348, 124 Stat. 3668 (2011).

Shark Savers. 2011. Would the world be better off without sharks? Available at [www.sharksavers.org](http://www.sharksavers.org).

Shivji, M., S. Clarke, M. Pank, L. Natanson, N. Kohler, and M. Stanhope. 2001. Genetic identification of pelagic shark body parts for conservation and trade monitoring. *Conser. Biology* 16(4): 1036-1047.

Southeast Data, Assessment, and Review [SEDAR 2011a]. 2011. SEDAR 21 Stock Assessment Report: HMS Dusky Shark. North Charleston, SC.

Southeast Data, Assessment, and Review [SEDAR 2011b]. 2011. SEDAR 21 Dusky Shark Assessment Summary.

Species Survival Network [SSN]. 2010. CITES COP 15, 2010 Factsheet. Species Survival Network: Washington DC.

Stevens, J., R. Bonfil, N. Dulvy, P. Walker. 2000. The effects of fishing on sharks, rays, and chimaeras (chondrichthyans), and the implications for marine ecosystems. *ICES Journal of Marine Science*, 57: 476–494.

Takahashi, T. 2011. Left out at sea: highly migratory fish and the Endangered Species Act. *California Law Review* 99: 179-233.

United Nations. Agreement for the Implementation of the Provisions of the United Nations Convention on the Law of the Sea on 10 December 1982 Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks. United Nations Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks. Sixth Session New York, 24 July-4 August 1995.

Walker, C. 2011. Assessing the Effects of Pollutant Exposure on Sharks: A Biomarker Approach, UNF Theses and Dissertations. Paper 141. Available at: <http://digitalcommons.unf.edu/etd/141>.

Wall, T. 2011. Dusky Sharks Not Safe at Home. Available at: <http://news.discovery.com/animals/dusky-sharks-not-safe-at-home-110428.html>.

Welch, W. 2010. Memorial service honors 11 dead oil rig workers. Available at: [http://www.usatoday.com/news/nation/2010-05-25-oil-spill-victims-memorial\\_N.htm](http://www.usatoday.com/news/nation/2010-05-25-oil-spill-victims-memorial_N.htm).

World Wildlife Fund Global [WWF]. 2005. International ban on shark finning adopted. Available at: <http://central-america.panda.org/about/countries/nicaragua/?uNewsID=21433>.