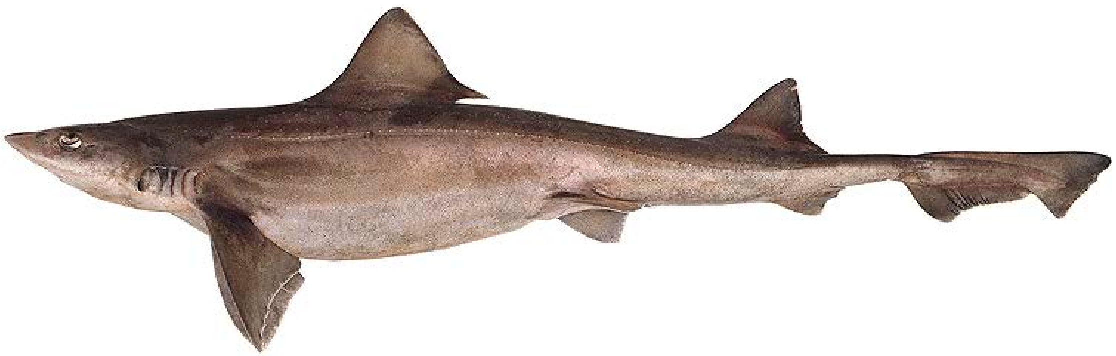
ENDANGERED SPECIES ACT STATUS REVIEW OF THE NARROWNOSE SMOOTHHOUND (*Mustelus schmitti*)



(INIDEP)

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Executive Summary

This status review report was conducted in response to a petition received from WildEarth Guardians on July 8, 2013 to list 81 marine species as endangered or threatened under the Endangered Species Act (ESA). NMFS evaluated the petition to determine whether the petitioner provided substantial information indicating that the petitioned action may be warranted, as required by the ESA. In a *Federal Register* notice on November 19, 2013 (79 FR 69376), NMFS determined that the petition did present substantial scientific and commercial information, or cited such information in other sources, that the petitioned action may be warranted for 19 species and 3 subpopulations of sharks, and thus NMFS initiated a status review of those species. This status review report considers the biology, distribution and abundance of and threats to a shark species from the Southwestern Atlantic, *Mustelus schmitti* (narrownose smoothhound).

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INTRODUCTION

Scope and Intent of the Present Document

On July 8, 2013, the National Marine Fisheries Service (NMFS) received a petition from WildEarth Guardians to list 81 species of marine organisms as endangered or threatened species under the Endangered Species Act (ESA) and to designate critical habitat. NMFS evaluated the information in the petition to determine whether the petitioner provided "substantial information" indicating that the petitioned action may be warranted, as required by the ESA.

Under the ESA, if a petition is found to present substantial scientific or commercial information that the petitioned action may be warranted, a status review shall be promptly commenced (16 U.S.C. §1533(b)(3)(A)). NMFS decided that the petition presented substantial scientific information indicating that listing may be warranted and that a status review was necessary for narrownose smoothhound, *Mustelus schmitti* (79 FR 69376, 19 November 2013). Experts and members of the public were requested to submit information to NMFS to assist in the status review process from November 19 through January 21, 2014.

The ESA stipulates that listing determinations should be made on the basis of the best scientific and commercial information available. This document is a compilation of the best available scientific and commercial information on the biology, distribution, and abundance of and threats to the narrownose smoothhound in response to the petition and 90-day finding. Where available, we provide literature citations to review articles that provide even more extensive citations for each topic. Data and information were reviewed through 31-July 2014.

LIFE HISTORY AND ECOLOGY

Taxonomy and Anatomy

The narrownose smoothhound (*Mustelus schmitti*, Springer 1939), also called the Patagonian smoothhound (Oddone et al. 2005, Segura and Milessi 2009), is a member of the family Triakidae (Massa et al. 2006). The narrownose smoothhound is called *gatuzo* in Spanish and *cação-cola-fina* and *caçonete* in Portuguese (Silva 2004, Massa et al. 2006).

There are at least four other species of the genus *Mustelus* that occur in the southwestern Atlantic with ranges overlapping the narrownose smoothhound: *M. canis, M. higmani, M. norrisi,* and *M. fasciatus* (Rosa and Gadig 2010). *Mustelus* species are often difficult to distinguish due to their conserved morphology and highly variable intraspecific meteristic characteristics. This problem is compounded in the southwestern Atlantic due to the presence of few scientific collection specimens, particularly of larger individuals, which leads to a lack of comparative ontogenetic observations that can be used for species diagnosis (Rosa and Gadig 2010). Our reviewers have stressed that more genetic and morphological work is need to distinguish the smoothhounds in this area. We have provided the distinguishing taxonomic characters that are currently accepted below.

Narrownose smoothhound have a slender body (body depth 7.1-10.9% total length (TL) and body width 9.9-11.3% TL) and a short head, with a prepectoral length that is 17-21% of the TL (Compagno 1984, Rosa and Gadig 2010). Their snout is bluntly angular (Compagno 1984) with a narrow internostril distance, 1.7-3.2% of the TL (Rosa and Gadig 2010). Mouth width is 4.4-6.3% TL and mouth dept is 1.5-3.5 % TL (Rosa and Gadig 2010). The narrownose smoothhound's eyes are large, fitting 2-3.1 times in the preorbital snout (Compagno 1984) and making up 2.1-3.8% of TL (Rosa and Gadig 2010). Labial folds are present and are longer on the upper jaw than on the lower jaw (Compagno 1984, Heemstra 1997, Rosa and Gadig 2010). Narrownose smoothounds are grey with numerous small white spots on their dorsal side and white on their ventral side (Compagno 1984, Heemstra 1997).

Narrownose smoothhound have a body form similar to other Triakids. The space between the first and second dorsal fin makes up 17-23% of the total length (Compagno 1984). The trailing edges of both dorsal fins have exposed ceratotrichia, a distinctive characteristic for the species (Rosa and Gadig 2010). The midbase of the first dorsal fin is closer to the bases of the pelvic fins than the bases of the pectoral fins (Compagno 1984). The pectoral fins are relatively small with the anterior margins being 12-16% of the TL (Compagno 1984). The anterior margins of the pelvic fins are 6.7-8.7% of the TL, making them relatively small (Compagno 1984). The pectoral and pelvic fins are broad and slightly concave on the rear edge (Heemstra 1997, Rosa and Gadig 2010). The height of the anal fin is 2.5-3.4% of the TL (Compagno 1984). The ventral lobe of the caudal fin is poorly developed (Heemstra 1997).

Narrownose smoothhound have a semi-pavement homodont dentition, with short tooth crowns and reduced cusps. In adults, the lower jaw has two more tooth rows than the upper jaw. In juveniles, differences in tooth row counts were not seen between the sexes and in the upper and lower jaws. For juveniles, the dental formula was 47-63/50-63, and it was 40-77/50-69 for adults. The total number of tooth rows increases with growth. Teeth in the upper jaw were longer than teeth in the lower jaw, while teeth in the lower jaw were wider than teeth in the upper jaw. Across all life stages narrownose smoothhound have an average tooth replacement rate of 4 days/series. Juveniles replace their teeth at a rate that is significantly slower than adults (Belleggia et al. 2014).

Narrownose smoothhound are most similar to *M. canis* within its range. Often it is adult narrownose smoothhound that are confused with juvenile *M. canis* (Rosa and Gadig 2010). *M. canis* tends to have larger eyes and browner coloration than the narrownose smoothhound. *M. canis* also lacks the exposed ceratotrichia on the dorsal fin margins and the small white spots on the dorsal flanks as seen with narrownose smoothhound (Rosa and Gadig 2010).

Range and Habitat Use

The narrownose smoothhound is found in the southwestern Atlantic from southern Brazil to southern Argentina between 22^{o}S and 47^{o}45’S (Figure 1; Belleggia et al. 2012). Rio de Janeiro is the northernmost limit in Brazil (Oddone et al. 2007). The southern limit of the narrownose smoothhound’s distribution is Ría Deseado, a protected area (Chiaramonte and Pettovello 2000). Narrownose smoothhound juveniles, adults, and gravid females migrate north into Brazilian waters in the winter and remain there from April to November (Haimovici 1997, Vooren 1997, Oddone et al. 2005, Massa et al. 2006). The migration is associated with cold water moving north into their Argentine range (Haimovici 1997). They are most common in waters off Uruguay in spring, summer, and autumn (December to April) (Vooren 1997, Oddone et al. 2005). In Argentina, abundance is highest in waters off Buenos Aires Province and northern Patagonia (Molina and Cazorla 2011). They are found at depths up to 120 m in Argentina, but in Brazil they have been captured as deep as 195 m (Belleggia et al. 2012). Narrownose smoothhound are found in waters with surface temperatures between 8-11.7^{o}C and bottom temperatures between 5.5 and 11^{o}C in Argentina (Menni 1985, Chiaramonte and Pettovello 2000). Wintering grounds in Brazil have water temperatures between 12 and 20^{o}C (Massa et al. 2006). Narrownose smoothhound have been reported in waters with salinities of 22.4 practical salinity units (psu) and higher (Molina and Cazorla 2011).

There are several known nursery areas for the narrownose smoothhound in Argentina: Bahía de Samborombón, Bahía Blanca/El Rincón, and inshore areas of Río de la Plata in Buenos Aires; and Bahía Engaño in Chubut (Oddone et al. 2005, Galíndez et al. 2010, Cortés et al. 2011, Molina and Cazorla 2011). All life stages are found in nursery areas in the spring but adult presence declines in the summer, while young-of-the-year and juveniles remain until autumn (Colautti et al. 2010). This residency pattern has also been seen in Ría Deseado, Argentina (Chiaramonte and Pettovello 2000). In Bahía Engaño, all life stages are present from spring through autumn (September-May), but juveniles are more abundant in spring (Van der Molen and Caille 2001). A small population of the Brazilian migrants was known to give birth in south Brazil in November and remain through February, but The IUCN Red List suggests that this population may have been extirpated (Massa et al. 2006).

There is a shift in the size and sex of narrownose smoothounds with their distribution. In Río de la Plata and El Rincón, Argentina, smoothhound size generally increases with depth, with smoothhounds less than 40 cm TL occurring more often in water less than 25 m. Larger individuals are also found in cooler waters with lower salinities (Cortés et al. 2011). In Uruguay, adult females were only found north of 35°30'S, which could be where mating takes place (Oddone et al. 2007). Females were also more common on the inner continental shelf at depths less than 50 m during spring and summer, while males were more common on the outer continental shelf (Pereyra et al. 2008). In the autumn and winter, both sexes are found on the outer continental shelf (Pereyra et al. 2008).

Figure 1. The range of the narrownose smoothhound from Rio de Janeiro, Brazil to Ría Deseado, Argentina based on the information collected in this review.

Diet and Feeding

Olivier et al. (1968) first characterized the diet of the narrownose smoothhound as carcinophagous, benthic infaunal, and ichthiophagous. The narrownose smoothhound is an opportunistic predator that generally feeds on epifaunal benthic organisms and the diet varies geographically and ontogenetically (Capitoli et al. 1995).

In Río de la Plata and El Rincón, Argentina, the diet is generally dominated by crustaceans, fishes, and polychaetes. Crustaceans were most important based on the index of relative importance (IRI), but polychaetes were the most abundant in number, while fish were dominant by weight. The most abundant crustaceans in the diet were decapods *Peltarion spinosulum*, *Leucippa pentagona*, and polychaetes in the Maldanidae and Sabellidae families. Coastal narrownose smoothhound consumed fewer fish than those in deeper areas. Crustaceans were more abundant in the diet in the northern part of Argentina than the southern part. As smoothhounds increase in body size, the consumption of polychaetes declined and was replaced by more fishes and crustaceans. The shift to crustaceans occurred around 60 cm TL, while smoothhounds about 85 cm TL fed primarily on fish. Based on diet information from this area, the trophic level calculated for narrownose smoothhound was 3.57 (Belleggia et al. 2012).

Temporal and ontogenetic variations in diet were also found for narrownose smoothhound in Anegada Bay, Argentina. In general, neonate smoothhounds were the more specialized feeders, with diet becoming more generalized as the species grew in size and age. In summer, decapods, particularly *Neohelice granulata*, had the highest index of relative importance (95% IRI) of the neonate diet (Molina and Cazorla 2011). Isopods were found consistently throughout the diet of all life stages, but polychaetes, decapods and bivalves were more common in juveniles and adults. Amphipods were fed on more by juveniles, while cephalopods were only preyed upon by adults. However, in the winter, amphipods, cephalopods, and stomatopods were absent from the diet of all life stages and the importance of decapods decreased. Neonates still fed primarily on *N. granulata* (Molina and Cazorla 2011). Based on diet information from this area, the trophic level was calculated at 3.51(Molina and Cazorla 2011), which is similar to that calculated by Belleggia et al. (2012).

Smaller scale diet studies in Argentina also found the diet to be dominated by epifaunal benthic organisms. In Ría Deseado, Chiaramonte and Pettovello (2000) found that the main prey item in adults was decapod crabs, *Cyrtograpsus angulatus,* followed by fishes, isopods (Family Serolidae), and polychaetes. Young of the year from this area ate mainly krill from the order Euphausiacea, along with *C. angulatus* and Serolidae (Chiaramonte and Pettovello 2000). In Bahía Engaño, crustaceans were found to be the most abundant prey group, primarily *Artemesia longinaris*. Polychaetes, teleosts, and cephalopods were present, but less numerous (Van der Molen and Caille 2001).

Growth and Reproduction

In general, narrownose smoothhound females grow faster and grow to a larger size than males (Chiaramonte and Pettovello 2000, Sidders et al. 2005, Segura and Milessi 2009). The maximum recorded size is 110 cm TL (Molina and Cazorla 2011). According to the IUCN Red List Assessment, maximum total length in Argentina is 90 cm for males and 108.5 cm for females. In Brazil, the maximum total length it is 78 cm for males and 96 cm for females. The model total length of narrownose smoothhound in Brazil is 60 cm for males and 72 cm for females (Massa et al. 2006).

Narrownose smoothhound are non-placental and reported to be yolk-sac viviparous (Hamlett et al. 2005, Galíndez et al. 2010), however other congeneric species examined are either placental or mucoid histotrophic viviparous (Musick and Ellis, 2005). Their reproductive cycle is annual with a gestation of 11 months followed by immediate ovulation and mating (Chiaramonte and Pettovello 2000). Pregnant females migrate offshore in late summer to early autumn, after mating in inshore areas. They return inshore to pup and mate again in the spring (Colautti et al. 2010). Reproduction occurs at different times, ranging from late November in northern Argentina to mid-December at the southern extent of its range (Molina and Cazorla 2011). Litter size varies between 2 and 14 pups with a mode of 8 pups per litter (Massa et al. 2006). Mean litter size varies between 4 and 5.73 pups per litter throughout its range (Sidders et al. 2005, Galíndez et al. 2010). Litter size increases significantly with maternal length (Oddone et al. 2005, Cortés 2007), but larger females do not produce larger offspring (Sidders et al. 2005). According to the IUCN Red List, the average individual annual fecundity is 8 (Massa et al. 2006). Size at birth is estimated at 24.4 $\pm$ 4.25 cm (Colautti et al. 2010), with the smallest free swimming neonate recorded at 25.2 cm TL (Chiaramonte and Pettovello 2000). Samborombón Bay, Bahía Blanca, Anegada Bay, Río de la Plata, and El Rincón are considered to be nursery areas for the narrownose smoothhound (Molina and Cazorla 2011).

Size at maturity varies throughout the narrownose smoothhound's range. In southern Patagonia, Argentina, claspers begin to elongate in males at 62 cm TL and are fully calcified by 76 cm TL, indicating maturity has occurred. Females begin maturing at about 45 cm and are mature by 79 cm TL (Chiaramonte and Pettovello 2000). In Anegada Bay, Argentina, 50% of the population is mature at about 55 cm TL in males and 56 cm TL in females, which is about 2.4 years of age for both sexes. All males are sexually mature by 61 cm and females at 64 cm, about 3.4 years of age (Colautti et al. 2010). The estimated size at which 50% of the males and females were mature was 59 cm TL and 72 cm TL, respectively, in Rio de la Plata, Argentina (Oddone et al. 2005). Off the coast of Punta del Diablo, Uruguay, the estimated size at 50% maturity was 59 cm for females and 56 cm for males (Segura and Milessi 2009). In the Argentine-Uruguayan Common Fishing Zone (AUCFZ), the estimated size at maturity was 57.6 cm for males and 59.9 cm for females (Cousseau et al. 1998). This is lower than estimates of 60 cm and 62 cm TL for males and females made by Menni et al. (1986) in the same area in the 1980s. Size at first breeding and mean total length have also decreased in Argentina (Diaz de Astarloa et al. 1997). In Brazil, Hiamovici (1997) estimated the age at maturity of narrownose smoothhound was 6 years, with a longevity of 11 years. Hiamovici (1997) did not specify if the age at maturity listed was age at 50% maturity or age at 100% maturity. The IUCN Red List Assessment lists length at 50% maturity in Brazil as 57 cm for females and 55 cm for males, in northern Argentina between 50.5 and 62.6 cm for females and 54.9 and 60 cm for males, and in Patagonia between 79.1 and 79.5 cm for females and 70.5 and 75.9 cm for males. Age at first breeding in Brazil is 4 years for females and 3 years for males, while it is 6.5 years for females and 5.7 years for males in Argentina. Longevity is listed as 9 years for males and 16 years for females in Brazil (Massa et al. 2006). More recently, Hozbor et al. (2010) estimated an age at maturity of 4 years for both sexes with a longevity of 20.8 years for males and 24.7 years for females.

Population Structure

The genetic structure of the narrownose smoothhound population was examined using one mitochondrial DNA marker to test if multiple stocks occur throughout its range (Pereyra et al. 2010). No distinct population structure was found among all of the sampling sites, and gene flow out of Mar del Plata was estimated to be less than one migrant per generation. The dominant haplotype was found to be widely distributed and present at all collection sites. However, nucleotide diversity was lower than that reported for other elasmobranchs and this may indicate that narrownose smoothhound experienced a genetic bottleneck or recent expansion which potentially occurred during the Pleistocene Era (Pereyra et al. 2010). Our reviewers have noted that more research is needed using other genetic markers to better determine the population structure of the narrownose smoothhound.

Demography

Using a stage-structured Lefkovitch matrix and life history parameters from animals collected off Mar del Plata, Argentina, Cortés (2007) determined the intrinsic rate of increase (*r*) for narrownose smoothhound is 0.175 per year (lower 95% confidence limit=0.030; upper 95% confidence limit=0.314) when the population is not subject to exploitation. Because of this higher intrinsic rate of increase, Cortés (2007) concluded that narrownose smoothhound could withstand higher levels of exploitation than other coastal sharks in the Buenos Aires Coastal Ecosystem. Exploitation was found to be sustainable when fishing mortality levels are close to 0.1, equivalent to an annual removal rate of about 10% of the population.

These demographic parameters place narrownose smoothhound toward the faster growing end of the "fast-slow" continuum of population parameters calculated for 38 species of sharks by Cortés (2002, Appendix 2). These species generally have higher potential to recover from exploitation.

In Brazil, the annual rate of population increase was calculated to be 1.058 between 1980 and 1994 (Massa et al. 2006).

DISTRIBUTION AND ABUNDANCE

To provide a better understanding of narrownose smoothhound's current distribution and abundance, an extensive search of scientific publications, technical reports, fishery bulletins, and museum specimen records was conducted. We also searched the Global Biodiversity Information Facility Database for museum specimen records. However, there is question on the validity of some records and the website does not guarantee the accuracy of the biodiversity data. Thus, while we do provide a summary of these records the accuracy of the records is not completely reliable.

The narrownose smoothhound is distributed throughout the southwestern Atlantic Ocean from Rio de Janeiro, Brazil to Ría Deseado, Argentina (Table 1; Oddone et al. 2007, Belleggia et al. 2012). Higher abundances of juveniles and neonates have been found in nursery areas throughout Argentina in Samborombón Bay, Bahía Blanca, Anegada Bay, Río de la Plata, El Rincón, and Ría Deseado (Chiaramonte and Pettovello 2000, Molina and Cazorla 2011). Adults are mostly found in offshore areas, migrating inshore in the spring to give birth and mate (Colautti et al. 2010).

Sexual segregation of males and females has been seen in both Argentina and Uruguay. Females showed a preference for shallower and cooler water than males (Menni 1985; Pereyra et al. 2008). Females also tend to be found in more northern areas off Uruguay in the summer, while males are found to the south (Oddone et al. 2007).

The narrownose smoothhound is the most abundant and widely distributed Triakid in the Argentine Sea (Van der Molen and Caille 2001). In 1994, narrownose smoothhound densities off Rio de la Plata were as high as 44 t/nm^2. The rest of the

Argentine-Uruguayan Common Fishing Zone had densities between 1 and 10 t/nm^2, but some areas had densities as high as 22 t/nm^2 (Cousseau et al. 1998). Based on research surveys and commercial fishing data, the abundance of the narrownose smoothhound in Argentina and Uruguay was estimated to be 156,065 t from November to December of 1999 (Figure 2; Massa et al. 2004a, b). Updated abundance estimates could not be found. The IUCN Red List assessment cites unpublished data from Massa and Hozbor stating that biomass in the main fishing areas, along the coast of Buenos Aires Province, Argentina, and Uruguay, has declined by 22% and national landings in Argentina decreased by 30% between 1998 and 2002 (Massa et al. 2006). Declines in abundance continued to be seen in Argentine waters through 2005 (Massa and Hozbor 2008). The IUCN Red List assessment also states that it is likely that Brazil's locally breeding population has been extirpated due to the Brazilian smoothhound fishery, contributing to the 85% population decline seen in the area (Massa et al. 2006, Molina and Cazorla 2011).

Table 1. Records of the narrownose smoothhound based on an extensive search of scientific publications, technical reports, museum specimen records, and the Global Biodiversity Information Facility Database (GBIF).

Year	Total Number	Area	Country	Source
1700	1	Maldonado	Uruguay	GBIF Database
1700	1	Maldonado	Uruguay	GBIF Database
1901	1	Bahía Blanca	Brazil	GBIF Database
1925	2	--	Brazil	GBIF Database
1925	2	--	Uruguay	GBIF Database
1944	1	Ribeirao, Santa Catarina	Brazil	GBIF Database
1944	1	Ribeirao, Santa Catarina	Brazil	GBIF Database
1950	1	--	--	GBIF Database
1961	2	--	Brazil	GBIF Database
1961	1	Mar del Plata	Argentina	GBIF Database
1964	1	Point Medanos	Argentina	GBIF Database
1966	1	--	Uruguay	GBIF Database
1966	5	--	Argentina	GBIF Database
1966	2	--	Brazil	GBIF Database
1970	4	--	Argentina	GBIF Database
1976	4	--	Argentina	GBIF Database
1978	31	--	Argentina	GBIF Database
1979	2	Lagoa dos Patos, Costa de Sao Jose do Norte, Rio Grande do Sul	Brazil	GBIF Database
1980	1	--	Brazil	GBIF Database
1980	1	Lagoa dos Patos, Canal Acesso, Rio Grande do Sul	Brazil	GBIF Database
1981	1	Rawson	Argentina	GBIF Database
1983	1	--	Brazil	GBIF Database
1983	8	--	Argentina	GBIF Database
1985-	570	Bahía Blanca	Argentina	Marcovecchio et

1986				al. 1991
1987	1	Argentine Sea	Argentina	GBIF Database
1988	1	Argentine Sea	Argentina	GBIF Database
1988	1	Tramandai	Brazil	GBIF Database
1991	2	Barra de Santos	Brazil	GBIF Database
1991	2	Imbai	Brazil	GBIF Database
1992	1	Golfo San Jose	Argentina	GBIF Database
1992	20	Bahía Blanca	Argentina	Galindez and Aggio 2002
1993	2	Necochea	Argentina	GBIF Database
1993, 1995, 2000	52	La Paloma, Mar del Plata, and Puerto Quequen	Uruguay and Argentina	Ivanov and Brooks 2002
1993-2006	--	Rio de la Plata and El Rincon	Argentina	Cortes et al. 2011
1994	1	Puerto Lobos	Argentina	GBIF Database
1994-1995	2255	Rio de la Plata	Argentina	Oddone et al. 2005
1994-1995	4824	Rio de la Plata	Argentina	Oddone et al. 2007
1994-1998	88	Argentine Sea	Argentina	Chiaramonte and Pettovello 2000
1995	1	Cassino Beach	Brazil	GBIF Database
1995	1	Santa Cruz	Argentina	GBIF Database
1995-1996	65	Bahía Engano	Argentina	Van der Molen and Caille 2001
1996	7	Rio Grande do Sul	Brazil	GBIF Database
1996-1997	95	Santos, Sao Paulo	Brazil	Gonzalez 1999
1997	2	--	Brazil	GBIF Database
1997	1	Torres	Brazil	GBIF Database
1997	1	Necochea	Argentina	GBIF Database
1998	1	Rawson	Argentina	GBIF Database
2001-2003	20	Mar del Plata	Argentina	Alarcos et al. 2006
2003-2004	637	Necochea, Buenos Aires	Argentina	Sidders et al. 2005
2003-2008	2290	Anegada Bay	Argentina	Colautti et al. 2010
2004	--	--	Uruguay	Pereyra et al. 2008
2004-2005	3429	Mar del Plata	Argentina	Cortes 2007
2004-2007	41	Bahía Blanca	Argentina	Rojas 2013
2005-2006	696	Punta del Diablo	Uruguay	Segura and Milessi 2009
2005-2008	99	Rio de la Plata	Argentina	Pereyra et al. 2010
2007-	103		Argentina	Belleggia et al.

2008				2014
2008	1577	Anegada Bay, Buenos Aires	Argentina	Molina and Cazorla 2011
2008-2009	525	Argentine Shelf	Argentina	Belleggia et al. 2012
2012	1	--	Brazil	GBIF Database
N/A	13	Rio Grande do Sul	Brazil	GBIF Database
N/A	1	Golfo San Matias	Argentina	GBIF Database
N/A	3	--	Uruguay	GBIF Database
N/A	1	Costa de Laguna	Brazil	GBIF Database
N/A	1	Argentine Shelf	Argentina	GBIF Database
N/A	4	Golfo Nuevo	Argentina	GBIF Database
N/A	1	Buenos Aires	Argentina	GBIF Database
N/A	1	Barra de Santos	Brazil	GBIF Database
N/A	1	Golfo San Jose	Argentina	GBIF Database
N/A	1	Puerto Rawson	Argentina	GBIF Database
N/A	1	Playa Union	Argentina	GBIF Database
N/A	3	Tramandai	Brazil	GBIF Database
N/A	3	Buenos Aires	Argentina	GBIF Database
N/A	1	--	Uruguay	GBIF Database
N/A	3	Playa Union, Bahía Engano	Argentina	GBIF Database
N/A	1	Golfo San Jose	Argentina	GBIF Database
N/A	1	Barra de Santos	Brazil	GBIF Database
N/A	1	Canal Villarino Viejo, Bahía Blanca	Argentina	GBIF Database
N/A	1	Mar del Plata	Argentina	GBIF Database
N/A	1	Squarema	Brazil	GBIF Database
N/A	1	--	Brazil	GBIF Database
N/A	2	Maldonado. Rio de la Plata	Uruguay	GBIF Database

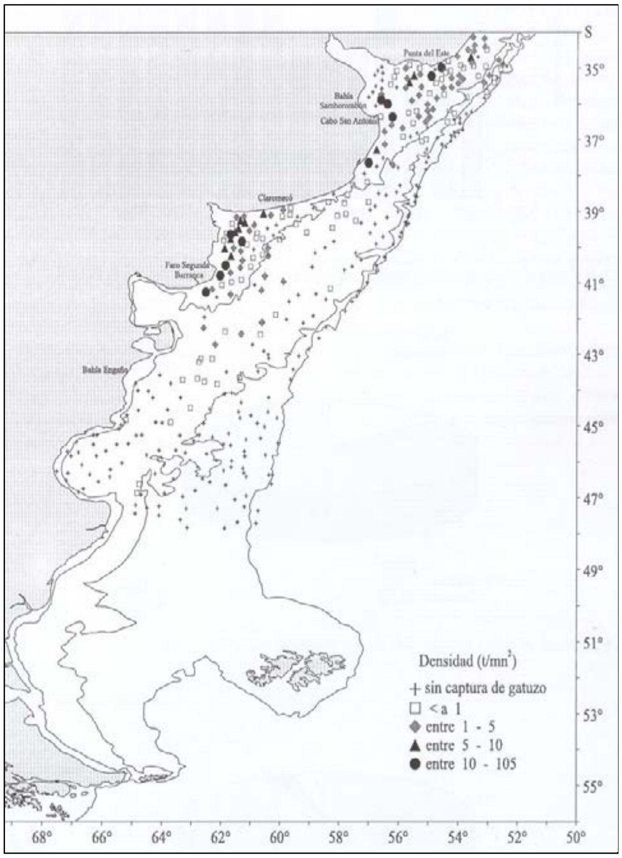

Figure 2. The distribution and density of the narrownose smoothhound from November-December, 1999 (Massa et al. 2004b).

ANALYSIS OF THE ESA SECTION 4(a)(1) FACTORS

NMFS is required to assess whether this candidate species is threatened or endangered because of one or a combination of the following five threats listed under section 4(a)(1) of the ESA: (A) destruction, modification or curtailment of its habitat or range; (B) overutilization for commercial, recreational, scientific, or educational purposes; (C) disease or predation; (D) inadequacy of existing regulatory mechanisms; or (E) other natural or human factors affecting its continued existence. Below we consider the best available information on each of the threat factors in turn.

Present or threatened destruction, modification, or curtailment of habitat or range

Various trawl fisheries occur throughout the species range. Studies show that the interaction of bottom trawling gears with bottom substrate can have negative effects on benthic fish habitat (Valdemarsen et al. 2007). These impacts are often the most serious on hard substrates with organisms that grow up from the bottom such as corals and sponges, but alterations to soft substrates have also been seen. The trawl doors on bottom otter trawls often cause the most damage to the ocean bottom, but other parts of trawling gear, such as weights, sweeps, and bridles that contact the bottom can also be damaging (Valdemarsen et al. 2007). Studies on the effects of trawling within the narrownose smoothhound's range have shown that large gastropods are frequently injured when caught as bycatch in hake trawls and discarded (Carranza 2006, Carranza and Horta 2008). Though the animals studied are not part of the narrownose smoothhound diet, damaged habitat and relocated animals could have indirect effects on the smoothhound by attracting scavengers, altering trophic relationships and potentially increasing competitive interactions (Carranza 2006). It is also likely that the animals that the narrownose smoothhound eats are similarly affected by trawling activities.

Overutilization for commercial, recreational, scientific, or educational purposes

Commercial Fishing

Narrownose smoothhound are intensely fished throughout their entire range, including several of their nursery grounds (Belleggia et al. 2012). Both industrial and artisanal fleets harvest the species. Landings have been reported to the Food and Agriculture Organization of the United Nations (FAO) from Argentina since 1960 and from Uruguay since 1993. Argentinian landings peaked in 1988 at 13,597 t and have fluctuated from about 6,000 to 12,000 tonnes since (Figure 3). Landings reported by Uruguay peaked in 1999 at 3,212 tonnes and have steadily declined to 2012.

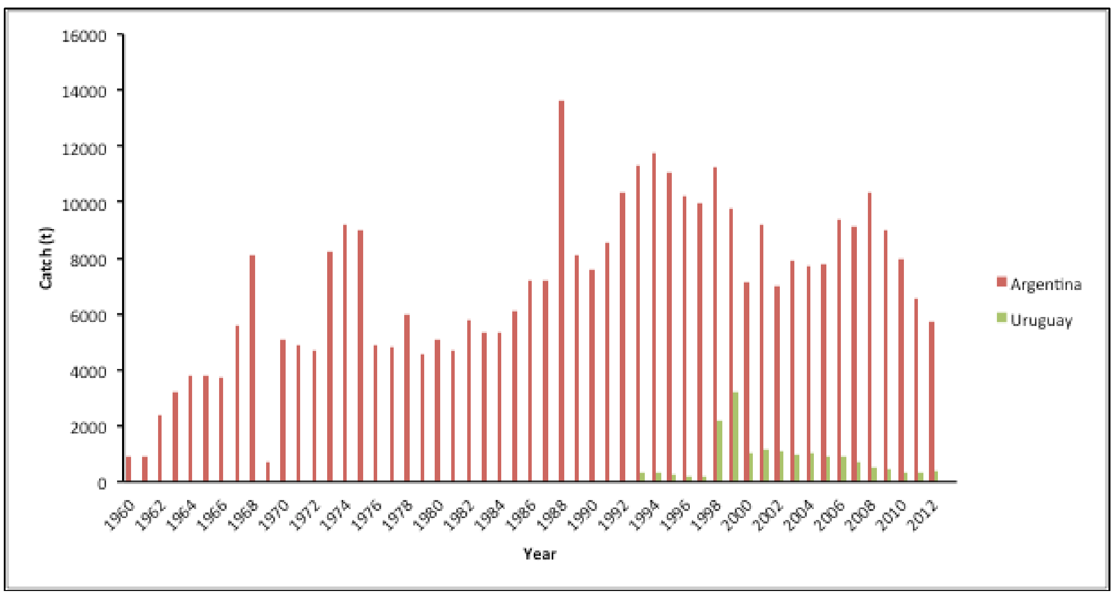

Figure 3. Annual landings of narrownose smoothhound reported to Food and Agriculture Organization of the United Nations by Argentina and Uruguay (source, FAO.org).

Narrownose smoothhound are targeted in artisanal fisheries in Uruguay using bottom fixed gill nets (Paesch and Domingo 2003, Segura and Milessi 2009). Artisanal fishermen targeting narrownose smoothhound in Uruguay mainly operate out of Punta de Diablo, Barra de Valizas, and La Paloma (Segura and Milessi 2009). Narrownose smoothhound are also caught as bycatch in Uruguay in inshore and offshore trawl fisheries, as well as inshore and offshore gillnet fisheries (Paesch and Domingo 2003, Domingo et al. 2008). Landings of smoothhounds in Uruguay (primarily *M. schmitti*, but also *M. fasciatus* and *M. canis*) increased dramatically between 1999 and 2000, reaching 1300 tons and then began to steadily decline, reaching approximately 850 tons by 2005 (Domingo et al. 2008). This is contradictory to the landings reported to the FAO that are referenced in Figure 2. Identifying the true species composition of shark catches in Uruguay can be difficult because catch is often reported by common name and the same common name is used for multiple species (Nion 1999). In 2009, the narrownose smoothhound was cataloged as overfished in the coastal regions of Uruguay (Defeo et al. 2009).

Narrownose smoothhound make up 9-12% of the total landings from coastal fleets in Argentina, making it the most important elasmobranch for Argentine fisheries (Galíndez et al. 2010). In the 1990s, the narrownose smoothhound was the main shark caught in the Argentine Sea based on an extracted biomass of 10,200 t for that time period and was the second most consumed domestic fish (Van der Molen et al. 1998, Chiaramonte 1998). Landings of narrownose smoothhound in Buenos Aires, Argentina were around 6,000 t per year from 1994-2002 (Molina and Cazorla 2011). Landings steadily increased after 2002, until they reached 9,000 t in 2008 (Molina and Cazorla 2011). We could not find any reports of updates on landings, but data reported to FAO indicate a decline since 2008.

The narrownose smoothhound is the most heavily exploited shark in artisanal fisheries in Argentina, especially in areas between 36^{o}S and 41^{o}S. The smoothhound artisanal fishing season in Argentina is from October 15 to December 15 and exclusively uses bottom gill nets. Narrownose smoothhound make up 96% of artisanal landings and range in size from 52-75 cm TL. Narrownose smoothhound are also caught in directed industrial shark fisheries in Argentina (Massa et al. 2004). In these fisheries, fishing effort for narrownose smoothhound steadily increased from 1991to 1998, while the total catch in the mid-1990s leveled out and slightly declined until significantly increasing in 1998 (Figure 4; Massa et al. 2004). Both effort and catch declined in 1999. Narrownose smoothhound are also caught as bycatch in commercial bottom trawls in Argentina, making up about 20% of the coastal harvest from these fisheries (Colautti et al. 2010). Pérez et al. (2011) found that CPUE for narrownose smoothhound has been increasing or maintaining a stable trend from 2000-2007 (Table 2). However, decreasing abundance, mean TL, and size at maturity indicates that the narrownose smoothhound was over exploited in Argentina (Massa 2013).

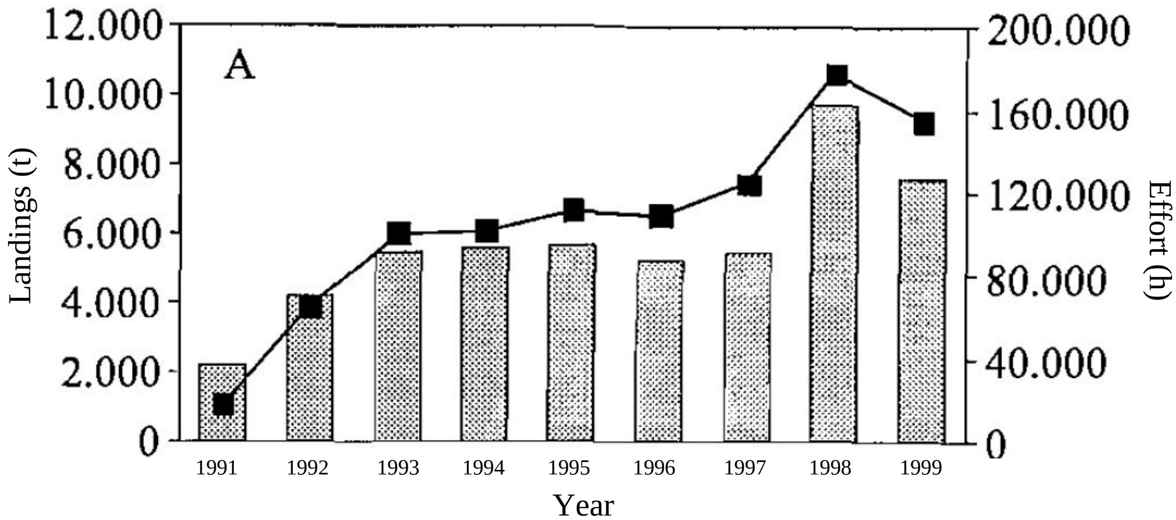

Figure 4. Trends in catch (grey bars) and effort (black line) for the narrownose smoothhound between 1991 and 1999 along the coast of Buenos Aires, Argentina and Uruguay (Massa et al. 2004).

Table 2. Mean values of CPUE (kg/h) between 34 and 42°S in Argentina from 1992-2007 (Pérez et al. 2011).

Year	Average CPUE (kg/h)
1992	31.32
1993	26.40
1994	32.19
1995	29.67
1996	28.18
1997	29.00
1998	37.18
1999	35.91
2000	25.00
2001	25.76
2002	36.30
2003	37.72
2004	35.09
2005	37.87
2006	42.36
2007	42.30

In the Argentine-Uruguayan Common Fishing Zone, narrownose smoothhound are the most heavily exploited shark, with Uruguay landing 1,000 t and Argentina landing 10,000 t per year (Segura and Milessi 2009). Though maximum permitted catch limits are set by both countries, population declines have been seen throughout the narrownose smoothhound's range, mostly due to increased fishing effort (Colautti et al. 2010, Molina and Cazorla 2011). Market demand for narrownose smoothhound is increasing, and continued intense fishing pressure has caused a chronological reduction in both maximum total length and total length at maturity (Cortés 2007, Molina and Cazorla 2011).

The majority of shark landings in Brazil between 1975 and 1997 were narrownose smoothhound and *Galeorhinus galeus* (Miranda and Vooren 2003). Narrownose smoothhound were landed in the Rio Grande Port from trawl and oceanic drift net fisheries from April to October (Miranda and Vooren 2003). The highest reported CPUE for a single trawl was 7 t/trip in 1985 (Miranda and Vooren 2003). Migratory narrownose smoothhound are fished intensely without regulation in Brazil, which has been reported to cause an 85% decline in population size (Molina and Cazorla 2011).

More detailed information on changes in fishing grounds, effort, and fishing methods over time could not be found for this review.

<u>Competition, Disease, or Predation</u>

Predation

Narrownose smoothhound are an important prey item for large sharks, including the broadnose sevengill shark (*Notorynchus cepedianus*), the copper shark (*Carcharhinus brachyurus*), and the sand tiger shark (*Carcharias taurus*) (Cortés et al. 2011). Predation levels on narrownose smoothhound are unknown.

Parasites

Some research has been done on the parasite load in the spiral intestine of the narrownose smoothhound. Cestodes were first recorded in narrownose smoothhound from Argentina by Ivanov (1997). In subsequent studies, the species *Echinobothrium notoguidoi*, *Calliobothrium australis*, *C. barbarae*, *C. lunae*, *Orygmatobothrium schmitti*, and *Eutetrarhynchus vooremi* were recorded in the spiral intestine (Ivanov 1997, Ivanov and Brooks 2002, Alarcos et al. 2006). The number of cestodes per host varied between 4-143 tapeworms, and there was no significant correlation between smoothhound size and parasite load (Alarcos et al. 2006). The number of species and total number of cestodes within the narrownose smoothhound is consistent with studies of parasites in other shark species (Alarcos et al. 2006) and thus does not suggest an unusual threat.

Disease

No diseases have been noted for narrownose smoothhound but some evidence of fungal infections has been reported. A survey of 95 individuals caught on the coast of Santos, Sao Paulo, Brazil, between March 1996 and May 1997 found 4 individuals with

Hifalomicose. Hifalomicose is a fungal infection that causes muscle necrosis with hyphal penetration into the cartilage. All infected individuals displayed necrosis on their snout and an additional infection from the yeast, *Fusarium solani*. The ulcers from the necrosis turn greenish and result in major bleeding, which leads to death. This infection can cause widespread infestations because the fungus is easily transmitted and has a fast life cycle (Gonzalez 1999).

One case of albinism has been reported in narrownose smoothhounds (Teixeira and Góes de Araújo 2002). The individual was caught in the winter of 1993 off of the coast of Rio Grande do Sul, Brazil. It was a completely white juvenile male, measuring 58.5 cm TL, with pink irises. Albinism is a rare genetic abnormality in elasmobranchs and has only been reporting in a handful of species (Teixeira and Góes de Araújo 2002).

Adequacy of Existing Regulatory Mechanisms

In 2004, the narrownose smoothhound was listed in Annex 1 on Brazil's endangered species list. This listing was renewed in 2014, when the narrownose smoothhound was listed on Annex 1as critically endangered (Directive N^{o} 445). An Annex 1 listing prohibits the catch of the species except for scientific purposes, which requires a special license from the Brazilian Institute of Environment and Renewable Resources.

The Comisión Técnica Mixta del Frente Marítimo, which sets fishing regulations for the Argentine-Uruguayan Common Fishing Zone, set the species-specific total permissible catch of narrownose smoothhound in 2014 at 4,500 t (Res. N^{o} 7/14). This is the same level that has been set since 2012 (Res. N^{o} 11/13, Res. N^{o} 9/12). In 2011, the total permissible catch was set for *Mustelus spp*., as opposed to narrownose smoothhound alone, at 4,000 t, which was lowered from the 4,850 t limit set from 2002 to 2010 (Res. N^{o} 5/11, Res. N^{o} 5/02).

Some regulations are in place to protect narrownose smoothhound nursery habitat. Ría Deseado, the southernmost limit of the narrownose smoothhound's range, is designated as a protected area, which protects the local population from being exposed to fishing (Chiaramonte and Pettovello 2000). Anegada Bay, Argentina, a known narrownose smoothhound nursery area, was designated as a multiple use zone reserve in 2001 (Colautti et al. 2010). The smoothhound fishery in Anegada Bay has been closed since 2008 in order to protect the local population (Colautti et al. 2010). In the Argentine-Uruguayan Common Fishing Zone, trawling is banned within five nautical miles of the coast (Pereyra et al. 2008). This coincides with the area where narrownose smoothhound pupping and breeding take place (Pereyra et al. 2008).

A trawling ban is in place in Uruguay between La Paloma and Chuy between 25 and 50 m deep in the summer to protect juvenile *Cynoscion guatucupa*, but this ban could also protect some of the narrownose smoothhound population (Pereyra et al. 2008). Additionally, Uruguay's area closure at depths of 50 m to protect juvenile hake (*Merluccius hubbsi*) in the spring, summer, and autumn corresponds with high use areas of the narrownose smoothhound population and could protect a portion of the population (Pereyra et al. 2008).

Uruguay's FAO National Plan of Action for the conservation of chondrichthyans lists the narrownose smoothhound as a species of high priority (Domingo et al. 2008). It sets short-term goals of 12-18 months to investigate distribution and habitat use, generate times series of effort and catch, and conduct an abundance assessment and mid-term goals of 24-30 months to determine maximum sustainable catch limits and conduct age, growth, reproduction, and diet studies. They made it a priority to review current fishing licenses that allow for the catch of narrownose smoothhound and possibly modify them and grant no new fishing licenses. The results gleaned from the goals and priorities of this plan could not be found. Argentina's FAO National Plan of Action for the conservation of chondrichthyans includes the narrownose smoothhound as one of its eleven species of priority (NPOA-Argentina 2009). Similar to Uruguay's plan, a priority listing calls for compiling the scientific information available on the species and makes goals for increased research and improved management. There are some general fishing regulations listed in Argentina's Plan that may provide some protection to narrownose smoothhound (Table 3).

Additionally, in December, 2014 the Instituto Chico Mendes de Conservação da Biodiversidade approved the National Action Plan for the Conservation and Management of the Elasmobranchs of Brazil (N° 125, Lessa et al. 2005). The narrownose smoothhound is listed as one of the twelve species of concern in the plan (Lessa et al. 2005). The plan includes short term, mid-term, and long term goals for elasmobranch conservation. The plan sets short term goals for improved data collection on landings and discards, improved compliance and monitoring by the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA), supervision of elasmobranch landings to ensure fins are landed with carcasses, the creation of a national port sampler program, and intensified on board observer monitoring programs. Mid-term goals include increased monitoring and enforcement within protected areas as well as the creation of new protected areas based on essential fish habitat for the 12 species of concern. They also call for improved monitoring of fishing from beaches in coastal and estuarine environments. Long term goals call for improved ecological data and stock assessments for key species as well as mapping of elasmobranch spatiotemporal distributions. This data will be used to better inform the creation of protected areas and seasonal fishing closures (Lessa et al. 2005).

Table 3. Legislations from national and provincial governments in Argentina for the conservation and sustainable use of fisheries resources that may afford some protection to the narrownose smoothhound (NPOA-Argentina 2009).

GENERAL REGULATIONS		
Res. SAGPyA N° 265/2000	Establishes a large area in the central Patagonian continental shelf where bottom trawlers are banned (180,000 km^2)	Effective from 09-06-2000
Res. CFP Nº 7/2000	Establishes a closed area to protect juvenile fish in the Rincón region.	Effective from 1st November to 28 February of each year.
Res. CFP Nº 1/2008	National Plan of Action to prevent and eliminate illegal, unreported and unregulated fisheries.	Effective from January 2008
Res. CTMFM N° 10/2000	Establishes fishing effort restrictions.	Effective from 13-12-2000

Res. CTMFM N° 09/2007, 02/2008 y 05/2008.	Establishes seasonal closed areas in order to protect juvenile hake.	Effective seasonally
Disp Direction of Fisheries Development (Bs. As.) N° 217/07	Regulates recreational fishing in Buenos Aires Province.	Effective from December 2007

Other Natural or Manmade Factors Affecting the Species

A 1991 study of metal bioaccumulation in sharks in Bahía Blanca, Argentina, found that narrownose smoothhound presented higher metal levels than sharks of the same species collected in other areas (Marcovecchi et al. 1991). Mercury concentrations in the muscle and liver tissues were higher than sharks living in the Argentine Sea. Additionally, narrownose smoothhound had abnormally high muscular cadmium levels when compared to other shark species from Bahía Blanca. Diet tends to be the most important source of trace metals in sharks, with fish providing a significant source of mercury and crustaceans providing a significant source of cadmium (Marcovecchio et al. 1991). High cadmium levels in narrownose smoothhound could be explained by the predominance of crustaceans in their diet (as discussed in the Diet and Feeding section above). No information was provided on the impact these metals could have on the survival of individuals in Bahía Blanca.

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