

CONSERVATION AND MANAGEMENT PLAN OF 3 SPECIES OF SHARKS, IN THE COLOMBIAN CARIBBEAN

RESUME

This plan is a pioneer in the conservation of 3 species of sharks: 'Carcharhinus porosus', 'Carcharhinus longimanus' and 'Sphyrna lewini'. On the Colombian Atlantic coast, a 58% reduction in the biomass of sharks and rays has been identified between 1970 and 2007 (García et al., 2007). We have registered a progressive decrease over time of the landing volumes and reduction in the average catch sizes, and in the insular zone of the Caribbean (Archipelago of San Andrés, Providencia and Santa Catalina) a strong fishery aimed at the extraction of these organisms, which captured mostly juvenile individuals (Castro-González and Ballesteros-Galvis, 2018). Despite this evidence of deterioration in elasmobranch populations, their extraction patterns have been poorly documented in Colombia. Additionally, it has been diagnosed that there is a clear deficiency of knowledge in different biological and ecological aspects that are relevant for the conservation and management of the species of sharks of species 'Carcharhinus porosus', 'Carcharhinus longimanus' and 'Sphyrna lewini'. The panorama described above and the need for the countries of the world to generate their own strategies for the ordering of cartilaginous fish, leads BOSQUE COLOMBIANO ORGANIZATION to formulate the National Action Plan for the Conservation and Management of Sharks (PAN-Tiburones Colombia). This plan is a pioneer in including management and conservation proposals for sharks in Colombia.

This is a national proposal in accordance with the regional particularity of the geographical areas of the Colombian Atlantic coast, differentiated by the fishing carried out in each one of them, the established fishing communities and the species of sharks and rays associated in the catches. The Action Plan is supported by the previous diagnostic document, consigned in this document. Finally, the Action Plan is structured in such a way that it covers investigative, legal and governance issues, surveillance and control, education and dissemination, management and conservation strategies, and a phase of permanent evaluation of progress in related activities and adjustments of the same Plan over time.

Keywords: Smalltail Shark, Oceanic Whitetip Shark, Scalloped Hammerhead Shark; Zenú indigenous community; sustainable fishing, extinction.

***Document drawn up by BOSQUE COLOMBIANO ORGANIZATION ¹, IUCN², the Zenú indigenous community³, and ambient territorial entities.

¹ BOSQUE COLOMBIANO ORGANIZATION, office@bosquecolombiano.org;

² IUCN South America regional

³ Zenú indigenous community, jefatura@comunidadzenu.com.co



Cite as: BOSQUE COLOMBIANO ORGANIZATION, F. 2019. Conservation and Management Plan Of 3 Species Of Sharks, In The Colombian Caribbean. BOSQUE COLOMBIANO ORGANIZATION and IUCN regional. 18 pag.

1. INTRODUCTION

To elaborate the diagnosis of the state of knowledge of sharks in the Colombian Atlantic coast, five matrices were designed that integrated the information at the species level, considering those most relevant and involved in the extraction processes for fishing. These matrices were made by the National Technical Committee of PAN-Tiburones Colombia, and included fisheries information - the fleet involved and fishing data - (two matrices), biological (one), socioeconomic (one) and conservation (one matrix).



The information recorded in each of these matrices was articulated with guidelines for the prioritization of species, considering the threats identified for sharks, through a scoring system taken and modified from Domingo et al. (2008), and the prioritized shark species were: Smalltail Shark (*Carcharhinus porosus*), Oceanic Whitetip Shark (*Carcharhinus longimanus*) and Scalloped Hammerhead (*Sphyrna lewini*).

Fishing: In relation to the extractive activity carried out in a certain area, a scoring scheme was established where four points were assigned for the species that are the target of a fishery that directs the effort specifically to this resource; three points for those specimens that are caught as companion fauna in three or more fisheries; two points for those species that are associated with the catches of two fisheries, and one point for those that are taken in a single fishery.

Species distribution: A score was established that relates the distribution of cartilaginous fish species registered in Colombia, where species with a very restricted distribution (presence in a marine ecoregion or in a single basin for continental waters) were awarded four points; species with restricted distribution (presence in two or three marine ecoregions or in two or three basins) were given three points; to marine species with distribution on the Caribbean coast (including insular areas) or to continental waters that are distributed in four or more basins, two points were set and, finally, species with distribution on both coasts were assigned one point.



Marketing: Based on the market demand for by-products derived from shark resources, the following points scheme was generated: for those species that are subject to commercialization at the local and / or national level and are regularly exported to the minus a by-product, four points; for species traded nationally, three points; to those traded only locally, two points and, finally, to the species discarded in the different fishing operations and not subject to commercialization, one point was assigned.

Conservation status: The categories established in the IUCN Red List were used to award points to each of the referred species; In this way, the species evaluated under these criteria were classified as follows: a component of threatened taxa (evident relationship of risk in a species) that could be critically endangered (CR), endangered (EN) or vulnerable (VU), where the difference between



these categories lies in whether the species are at extremely high, very high or high risk of extinction in the wild, respectively; and a component of individuals classified as near threatened (NT) and with least concern (LC), which lists in the former the species that are close to meeting the criteria of evident risk and in the latter (LC), those that are abundant, widely distributed and do not meet the threat criteria.



There are two other components that illustrate species that, despite having been evaluated, do not present enough information to grant them a category (Deficient Data - DD), and another group of individuals that have not received any type of evaluation (No Evaluated - NE) (Musick, 1999). Given the aforementioned, four points were assigned to those species that are in the category of threat (CR, EN, VU) in the national and international Red List, three to species with categories of threat (CR, EN, VU) in the national red list and with another category in the international list (NT, LC, DD), two points to species with another category (NT, LC, DD) at the national level and one point to those species Not Evaluated (NE).



Qualification: Four categories of action were established (Very High, High, Medium and Low), considering as a Very High priority for those species

that added 12 points or more, High priority for those that added from 9 to 11 points, Medium priority to those that added six to eight points and Low priority for those that added five points or less. The species that are listed in Appendix II of CITES, were located in the highest category of action (Very High) due to the commitment that the country acquires to ensure their international trade.



Lines of Action

The National Action Plan presents a set of lines of action that are based on a series of regional and national proposals and strategies, which have been distributed to be developed in the short, medium and long term, according to the urgency to carry them out. It was established that a short-term action is framed within an execution period of no more than three years, in the medium term between four and five years, and in the long term between six and ten years.

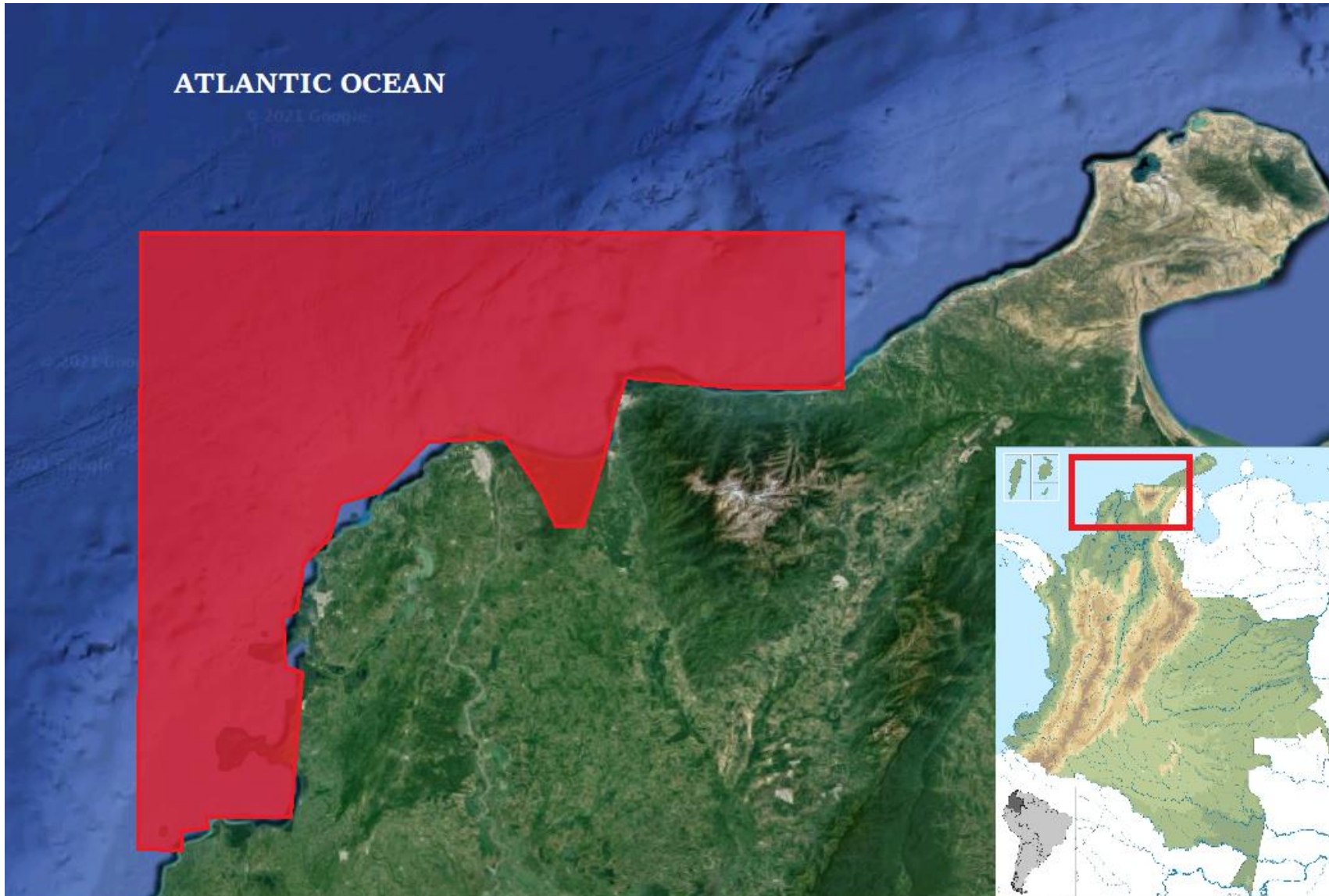


The species that are in the Very High and High categories will be associated with activities and projects to be developed in the short term and those of Medium and Low priority, with medium and long-term actions, respectively. It is important to emphasize that the categorizations of the species

will be updated as the Action Plan is implemented and periodically evaluated.



AREA OF INFLUENCE OF THE PROGRAM



CONSERVATION AND MANAGEMENT PLAN OF 3 SPECIES OF SHARKS, IN THE COLOMBIAN CARIBBEAN


CONVENTIONS

 Program area

GEOGRAPHICAL POSITION

1. **Departments:** Sucre, Bolívar, Magdalena, Guajira
2. **Country:** Colombia
3. **Geographical coordinates**
From the Ciénaga de Magdalena:
11°01'10.0"N 74°39'08.5"W;
To Punto Guamachito:
11°24'32.6"N 73°08'16.9"W

SCALE


1cm = 50,000m

SOURCE:

- BOSQUE COLOMBIANO ORG
- IMAP: geographic data bank of biodiversity of Colombia.
- Google Maps.

2. PRIORITIZED SPECIES

2.1. SMALLTAIL SHARK

(*Carcharhinus porosus*)



Taxonomy

Order Carcharhiniformes

Family Carcharhinidae

Common name

Porous Shark, Dogfish, Hard Leather, Small tail Shark

2.1.1. IUCN RED LIST CATEGORY AND CRITERIA

Critically Endangered (CR, A2d)

Justification

The Smalltail Shark (*Carcharhinus porosus*) is a small (<150 cm total length) coastal requiem shark that historically occurred in the Western Central and Southwest Atlantic Oceans from the central, western and southern Gulf of Mexico and along the Caribbean coast of Central and South America to the state of Paraná in southern Brazil, not including the Caribbean Islands. This shark inhabits muddy inshore areas and estuaries to a depth of 84 m and is captured in artisanal gillnets and in commercial trawl fisheries. The meat is likely to be consumed for subsistence or sold locally in most places. The probability of catching this shark over time has declined in all parts of its range from 1970 to 2015, with particularly drastic declines in the southern Gulf of Mexico and off South America. In northern Brazil, this species is still captured in shrimp trawls and gillnet fisheries in Amapá and Pará, but numbers have declined significantly, and it is now rare in Maranhão. Catch

rates decline from 2.87 kg per hour to 0.43 kg per hour in the 2000s, equivalent to a population reduction of 85% over three generation lengths (27 years). Records are becoming increasingly rare across eastern and southern Brazil, where this species has not been recorded for more than 15 years from the eleven states between Ceará (in the northeastern Brazil), to Paraná (in the southeastern Brazil). Demographic modelling suggests the fishing mortality far exceeded population growth rates and a population reduction of >90% over three generations was estimated for the core distribution of this species. Due to the intense and largely unmanaged nature of fisheries in the region, the decreasing probability of catches, the relative lack of recent records in many parts of its range, and alarming declines in other elasmobranchs in the core of its range (northern South America), it is suspected that this shark has undergone a population reduction of >80% over the past three generation lengths (27 years) due to levels of exploitation, and the Smalltail Shark is assessed as Critically Endangered A2d.

2.1.2. Diagnosis

Slender body, long snout and narrowly rounded at the tip. The teeth with serrated edges, those of the upper jaw with narrow cusps, oblique to the sides, those of the lower jaw with high narrow cusps, erect in front, oblique towards the posterior area. Spiracles absent, gill slits relatively short. The first dorsal fin is moderately low, with a widely convex anterior margin, narrow and rounded apex, its origin is anterior to the free apex of the pectoral fin.

Second dorsal fin high, although much smaller than the first, originating above or slightly behind the midpoint of the base of the anal fin. Pectoral fin with short and rounded apices. Interdorsal crest absent and keels on caudal peduncle. Coloration: light grayish back to blue or lead; belly, flanks and pelvic fins clear, but tinged with reddish color in some individuals. The tips of all its fins are dark or light in color. Size reaches sizes of 1.5 m TL (Navia et al. 2011).

2.1.3. Geographical distribution

Global: in the western Atlantic, from the Gulf of Mexico to southern Brazil. National: in the Colombian Caribbean there are records of the species from Acandí to Carrizal, also in Palomino, Isla Fuerte, San Bernardo islands, Rosario islands, Barú and Ciénaga Grande de Santa Marta (Rey and Acero



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2002, Arévalo et al. 2004, Vishnoff 2008, Grijalba et al. 2009). Depth range: 0 to 36 m (Navia et al. 2011).

2.1.4. Population

There is no information on the population aspects of this species in Colombia; however, in the Caribbean it is considered a rare species in fisheries bycatch. Vishnoff (2008) recorded 14 specimens in Isla Fuerte with sizes between 74.4 and 88.4 cm TL, of which 12 were mature females, two of them with embryos with intermediate stages and advanced development.

2.1.5. Ecology

It is a benthopelagic species that inhabits coastal areas on the shallow continental shelf, estuaries and muddy bottoms, at depths greater than 30 m. It feeds on fish, including small hammerhead sharks, rhizoprionodones, and shrimp (Froese and Pauly 2016). It is a placental viviparous species. Males they mature sexually between 226-290 cm TL and females between 250-350 cm TL. They have between 10 to 82 young per litter that are born with sizes between 51-104 cm TL. The gestation period is estimated between 13-16 months (Navia et al. 2011).

2.1.6. Applications

There is no specific information on the use and commercialization of the species in the Colombian Caribbean. However, as it occurs in other species of sharks, the consumption of meat, the commercialization of fins, as well as the use of liver and skin are presumed (Fabio Gómez, unpublished data).

2.1.7. Threats

The potential association of this species with different fisheries and the degradation of coastal habitats are the main inferred threats. Likewise, the interaction of gravid females in the Isla Fuerte artisanal fishery shows a possible greater impact on the populations of the species.

2.1.8. Conservation measures taken

In Colombia there are no specific conservation measures for this species, however, the species is covered under the prohibition of fishing for sharks, rays and chimaeras in Colombia (Resolutions 0744 of 2012 and 0190 of 2013 of the AUNAP) and the practice of finning (Resolution 0375 of 2013 of the AUNAP). Further, the species was considered with

Medium Priority in the Action Plan National for the Conservation of Sharks, Rays and Chimeras of Colombia - PAN-Tiburones Colombia (Caldas et al. 2010), which was adopted by Presidential Decree number 1124 of 2013 and involves a Monitoring Committee created by Resolution 0272 of 2014 on Minagriculture, which has generated a formal mechanism for the implementation of the actions of the plan.

2.1.9. Proposed conservation measures

Inferring the presence of the species in different fisheries, both artisanal and industrial, where a large number of sharks arrive that are not identified or are included in a general item of carcharhinids, it is necessary to guide research that can evaluate the pressure of fishing on the species, as well as their vulnerability and resilience to it.

2.2. OCEANIC WHITETIP SHARK (*Carcharhinus longimanus*)



Taxonomy

Order Carcharhiniformes
Family Carcharhinidae

Common name

Oceanic whitetip shark, Oceanic
Whitetip shark



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2.2.1. IUCN RED LIST CATEGORY AND CRITERIA

Critically Endangered A2bd

Justification

The Oceanic Whitetip Shark (*Carcharhinus longimanus*) is a large (to 350 cm total length) wide-ranging, oceanic species of tropical and temperate seas worldwide with a preference for surface waters, though it has been reported to depths of 1,082 m. It has litters of 1–15 pups and likely has a biennial reproductive cycle. The species is caught globally as target and bycatch in pelagic large- and small-scale longline, purse seine, and gillnet fisheries and is often retained for the meat and fins, unless regulations prohibit retention. The species has a high catchability due to its preference for surface waters and its inquisitive nature. Steep population declines have occurred in all oceans. The Oceanic Whitetip Shark was once one of the most abundant pelagic shark species in tropical seas worldwide but is now rare in some regions. The global population is estimated to have undergone a reduction of > 98%, with the highest probability of > 80% reduction over three generation lengths (61.2 years). Therefore, the Oceanic Whitetip Shark is assessed as Critically Endangered A2bd.

2.2.2. Diagnosis

Moderately robust body with a relatively short, rounded muzzle. Rounded eyes and rudimentary nose flaps. The upper and lower anterior teeth have differences, the former are triangular, straight and serrated, and the latter are tall, straight and with slender tips. First dorsal fin large with its rounded apex and a very characteristic white coloration, its origin is slightly anterior to the posterior inner vertex of the pectoral fins; pectoral fins very long, broad and with rounded white tips; origin of the second dorsal on the anal fin and caudal fin with the lower lobe well developed (Compagno 2002a, Navia et al. 2011, Robertson and Allen 2015, Robertson et al. 2015). Color: generally dark gray back, sometimes brown or bluish and white belly, sometimes with yellowish reflections; First dorsal fin tips, paired fins and tail fin lobes widely speckled with white. Ventral surface of pelvic fins, anal fin tips and second dorsal fin and ventral lobe of tail fin often with black spots. Saddle-shaped black spots in front of the second dorsal fin and on the dorsal edge of the fin caudal (Compagno 2002a, Navia et al. 2011). Size: reaches a maximum size of 350-395 cm TL, being common at 270 cm TL (Robertson and Allen 2015).

Global geographic distribution: it is considered the only true Oceanic shark of the genus *Carcharhinus*,

which is distributed in tropical and subtropical waters around the world between 30° north and 35° south (Baum et al. 2006). Its area of distribution includes the western Atlantic Ocean, and possibly the Mediterranean Sea. In the Indo-Pacific region it is found from the Red Sea and the East African coast to Hawaii, Samoa, Tahiti and the Tuamotu Islands. In the eastern Pacific Ocean, the range is from southern California, in the southern United States, to Peru (Compagno 1984c). It is distributed throughout the entire western Atlantic, from Bermuda to Uruguay and Argentina, including the Caribbean Sea (Compagno 2002a). National: it is distributed in the Caribbean region in oceanic waters, there are records off the coast of Cartagena, Santa Marta and the department of La Guajira (Caldas and Correa 2010b, Rueda et al. 2014a). It has been registered on the island of Providencia (Bolaños-Cubillos et al. 2015). For the Pacific there are references that associate the species with the exclusive economic zone of the country (Mejía-Falla et al. 2007) and there is a specific record in the vicinity of Malpelo Island (Robertson and Allen 2015). Depth range: 0 to 200 m (Robertson et al. 2015).

2.2.3. Population

The oceanic whitetip shark has been categorized as Vulnerable (VU) globally, taking into account the decline in the catches of various fisheries in which the species interacts. Even in the central and northwestern Atlantic, estimated population declines of 70% and 99.3% between the decades of the 50s and 90s of the last century led to the species being considered Critically Endangered (Baum et al. 2006). In Colombia there is no information on population aspects of the oceanic whitetip shark, and only few data are known from records and catches in the Caribbean, mainly juveniles and in low numbers (Caldas and Correa 2010b, Rueda et al. 2014a), representing less than 1% of bycatch with pelagic longline (Rueda et al. 2014a). The few years with information on the aforementioned fishery do not allow us to infer any trend on the abundances associated with the catches.

2.2.4. Ecology

It is a pelagic species, considered the only true oceanic shark of the genus *Carcharhinus*, normally found in the high seas on the outer continental shelf or around islands oceanic in deep waters. Oceanic



whitetip sharks are major trophic level predators in the sea open, which feed mainly on teleosts and cephalopods (Backus et al. 1956), although some studies indicate that they also capture waterfowl and marine mammals (Compagno 1984c).

Cortés (1999) determined the trophic level of the oceanic whitetip shark at 4.2 (maximum = 5.0). It is a placental viviparous species, with a reproductive cycle of two years, a gestation period of 9-12 months, fecundity of 1-14 offspring with an average of 5-6, depending on the geographical location (Seki et al. 1998). Males mature between 175-198 cm TL and females between 180-200 cm TL (Compagno 2002a).

2.2.5. Applications

The oceanic whitetip shark is used in a variety of ways among different national economies. Vannuccini (1999) mentions that the meat of this shark is eaten fresh and smoked in Mexico and the United States, and fresh, dried and salted in Seychelles and Sri Lanka. Sometimes the liver is also removed for the oil, and the skin is used leathery. In Colombia there is no specific information on the commercialization of the species, knowing only that in the bycatch of industrial ocean longline fishing it is retained for its meat and its fins (Caldas and Correa 2010b).

2.2.6. Threats

The oceanic whitetip shark is one of the tropical pelagic species most commonly obtained as bycatch in tuna and swordfish fisheries, where the catches are not accurately recorded, so they could be higher than what is documented in some areas (Bonfil and Abdallah 2004, Clarke 2008). The main threat that the species has in Colombia is its interaction with fisheries, finding that it is rare in pelagic longline catches in the Caribbean Sea, with a predominance of juvenile individuals (Caldas and Correa 2010b, Rueda et al. 2014a), which could be impacting development areas of this species.

2.2.7. Conservation measures taken

In Colombia there are no specific conservation measures for this species, but for the Colombian insular Caribbean (archipelago of San Andrés, Providencia and Santa Catalina) fishing directed at sharks is prohibited (Resolution 003333 of 2008 of the ICA), as well as the retention of any specimen caught incidentally (Judgment 88001-23-31-000-2011-00009-1). Fishing directed at sharks and rays is

prohibited in the country. and chimeras, as well as the use of steel cables in the reinals in the tuna fishery with oceanic longline, spinel and / or longline (Resolutions 0744 of 2012 and 0190 of 2013 of the AUNAP) and the practice of finning (Resolution 0375 of 2013 AUNAP), measures that seek to reduce bycatch and retention of captured animals, respectively. In addition, Colombia, as part of the Inter-American Tropical Tuna Commission, welcomes Resolution C-11-10 that prohibits retaining and bringing up on deck any specimen of this species in the fisheries of the tropical Pacific Ocean that are part of this organization. *C. longimanus* is considered Vulnerable (VU) globally due to the fishing pressure it suffers throughout its range, especially by pelagic fisheries (Baum et al. 2015).

2.2.8. Proposed conservation measures

Considering the information that has been generated in the pelagic longline tuna fishery in the Caribbean region, it is necessary to orient research to assess the pressure of this fishery on the species; Equally important is being able to generate accurate information on the presence and interaction of the species in the fisheries of the Colombian Pacific.

2.3. SCALLOPED HAMMERHEAD (*Sphyrna lewini*)



Taxonomy

Order Carcharhiniformes
Family Sphyrnidae

Common name

Horny, Hammerhead Shark, Horned, Hammerhead Shark

Synonymy

Sphyrna couardi Cadenat 1951

Zygaena lewini Griffith & Smith 1834

2.3.1. IUCN RED LIST CATEGORY AND CRITERIA

Critically Endangered A2bd

Justification

The Scalloped Hammerhead (*Sphyrna lewini*) is a large (to 420 cm total length) coastal and semi-oceanic pelagic shark that is circumglobal in warm-temperate and tropical seas, from the surface and intertidal zone to depths of 1,043 m. The global population structure varies between males and females; males move across ocean basins, while females only move regionally. The species is caught globally as target and bycatch in pelagic commercial and small-scale longline, purse seine, and gillnet fisheries, and is retained for the meat and fins. The Scalloped Hammerhead has undergone steep declines in all oceans, with some signs of stabilization and possible recovery in response to management only in the Northwest Atlantic and Gulf of Mexico. The weighted global population trend estimated median reductions of 76.9–97.3%, with the highest probability of > 80% reduction over three generation lengths (72.3 years), and is therefore assessed as Critically Endangered A2bd.

2.3.2. Diagnosis

Species with an elongated and fusiform body, head with hammer-shaped cephalic expansions and five notches; nostrils and eyes located at the ends of the cephalic expansions; the nostrils have well developed preanarinal orifices; broadly rounded mouth. The first dorsal fin is high and moderately falcate back, the second dorsal fin is small and originates well behind the origin of the anal fin. The base of the anal fin is wider than the base of the second dorsal fin; the pectoral fins are short and broad, and its pelvic fins have an almost straight back edge. Color: gray-brown back and pale belly; fins with dark tips on the ventral part, mainly in juveniles. Size: can reach up to 4.2 m LT (Robertson and Allen 2015, Hleap et al. 2011).

2.3.3. Geographical distribution

Global: circumglobal species from temperate and tropical waters. It is distributed throughout the

tropical eastern Pacific and the Atlantic western from New Jersey to Uruguay, including the Gulf of Mexico and the Caribbean Sea.

National: it has been recorded in its different stages of development in almost the entire Colombian Pacific coast, as well as in oceanic areas, including Malpelo Island (Tapiero 1997, Navia et al. 2008a). In the Colombian Caribbean, it has been recorded in the north of the Archipelago of San Andrés, Providencia and Santa Catalina, in Serrana key and Tres Esquinas platform (Caldas 2002, Castro-González and Ballesteros-Galvis 2009); as well as on Providencia Island (Grijalba et al. 2009). For the continental Caribbean, it has been recorded in Isla Fuerte (Orozco 2005, Vishnoff 2008, Almanza 2009, Gómez et al. 2006), Cartagena Bay (Dahl 1964), Morrosquillo Gulf, Rosario Islands, Puerto Colombia and Camarones (Rey y Acero 2002), Bocas sector of Ash in Barranquilla (Anguila and Hernández 2011), Ciénaga Grande de Santa Marta sector (Gaitán-Espitia and Galofre 2008), Santa Marta (Arriaga et al. 1999), PNN Tayrona (Gaitán-Espitia and López-Peña 2008) and La Guajira (Gómez-Canchong et al. 2004).

The species was recently recorded in oceanic Caribbean waters (Caldas and Correa 2010a). Depth range: between 0 and 400 m (Robertson and Allen 2015, Hleap et al. 2011), although it has been recorded up to 1000 m (Bessudo et al. 2011).

2.3.4. Population

This species was very abundant in industrial white fishing in the Colombian Pacific, representing high percentages of shark catches between 1993-1995 (Tapiero 1997). Navia and Mejía-Falla (2016) noted the almost total decrease of *S. lewini* juveniles in the total catches of the industrial shrimp fishery in the Gulf of Tortugas between 1995-2004, without having records of the species for 2007.

Data on landings of the species register individual between 24-289 cm TL, that is, from newborns adults close to the asymptotic size reported for the species in the Colombian Pacific (294.1 cm TL), where most of the individuals were female (81.5%). Likewise, most of these individuals (73.7%) were captured below the maturity size (200 cm TL) calculated for the species in the Colombian Pacific (Tapiero 1997, Mejía-Falla and Navia 2011b). Data from 2012-2014 indicate similar average catch sizes



between industrial (53-54 cm TL) and artisanal (51-53 cm TL; SEPEC data).

In swept area studies, captures of the species were recorded between 26-38m depth with a range of sizes between 50-59 cm TL (Zapata et al. 1999a). 2012-2014 landings data from artisanal (trammel) and industrial (CAS) fishing indicate that 99% of the catches corresponded to immature individuals (Squalus Foundation, unpublished data). Records of landing volumes of industrial fishing indicates a maximum value Ecology *Sphyrna lewini* is a coastal and oceanic species, depending on its state of life. In the Colombian Pacific, juveniles prefer coastal waters in protected areas and river mouths (Gómez and Díaz 1979), while adults are found in oceanic waters. (Tapiero 1997, Navia et al. 2008, Bessudo et al. 2011). Tapiero (1997) carried out a biological study of the species during a period of 18 months, with animals obtained in artisanal and industrial fishing operations. This author determined isometric type growth for the species ($b = 3.02$; $n = 522$ individuals) and estimated an asymptotic length of 294.1 cm TL and a growth rate of 0.18 cm / year from length frequency analysis. At the reproductive level, it found that females present both functional uteri, average fecundity of 14 embryos per female (2-25) with a sexual ratio 1: 1, length at birth 47.4 cm TL, and length at first maturity of 200 cm TL for females and 150 cm TL for males.

2.3.5. Applications

The species is considered of high commercial value in the Colombian Pacific, as its meat is consumed locally and nationally, the fins are exported and the liver is used to extract oil. Its meat is of high commercial value in the port of Buenaventura, in relation to other species of sharks, and is the one with the highest sales in the interior from the country. Their jaws and teeth are also traded for handicrafts and their vertebrae to sell shark cartilage for cancer medical purposes (Navia et al. 2008a). In the Caribbean, *S. lewini* meat is consumed locally and the liver is used to make oil (Vishnoff 2008, Almanza 2009, Anguila and Hernández 2011). The fins of larger specimens are sold to intermediaries for commercialization (Caldas et al. 2009, Anguilla and Hernández 2011).

2.3.6. Threats

This species is caught regularly in industrial white fishing (driftnet), although it is also caught at an artisanal level with hand lines and longlines in all its stages of life. A) Yes Likewise, shallow-water shrimp fishing has a great impact on *S. lewini* populations, catching mainly juveniles. The threat generated by capture in different fisheries and in all stages of development is aggravated by some biological characteristics of the species, such as slow growth and low productivity.

Due to the migratory behavior in large concentrations, this species is very susceptible to being caught in large numbers by coastal and oceanic fisheries; since those groupings they are mainly made up of females the threat is even greater.

2.3.7. Conservation measures taken

In Colombia there are no specific conservation measures for this species; however, for the Colombian insular Caribbean Fishing directed at sharks is prohibited (ICA Resolution 003333 of 2008), as well as the commercialization and distribution of sharks and derived products (process 88001-23-31-000-2011-00009-1). In addition, in the country in general, directed fishing for sharks and the use of steel guayas are prohibited in the reinals in the oceanic longline tuna fishery (Resolutions 0744 of 2012 and 0190 of 2013) and the practice of finning (AUNAP Resolution 0375 of 2013). In the National Action Plan for the Conservation of Sharks, Rays and Chimeras of Colombia (PAN-Tiburones Colombia, Caldas et al. 2010) the species is listed with Very High Priority, so conservation actions are urgent. The PAN-Sharks Colombia was adopted by Presidential Decree 1124 of 2013 and involves a Monitoring Committee (Resolution 0272 of 2014 of Minagriculture), which has generated a formal mechanism for the implementation of the actions associated with the PAN-Sharks in the country. This species is included in the National Plan for Migratory Species (Caicedo-Pantoja et al. 2009) and in Annex I of the highly migratory species of the United Nations in the Law of the Sea.

2.3.8. Proposed conservation measures

Considering the presence of the species in the catches of the fishery considered as "white fishing", it is necessary guide research to assess the pressure of this fishery on the species, as well as its vulnerability and resilience to it.

CONSERVATION AND MANAGEMENT PLAN OF 3 SPECIES OF SHARKS, IN THE COLOMBIAN CARIBBEAN

GENERAL OBJECTIVE

1. Establish a comprehensive elasmobranch conservation strategy within anp's that allows to strengthen the management measures and sustainable use of these species, mitigating the possible threats to their habitat and incorporating the participation of the main actors and users of the resource.

SPECIFIC OBJECTIVES

a. Have a coordination framework between the main actors and all instances competent for the management of elasmobranch populations within the polygons of anp with marine component.

b. Establish the necessary activities in the short, medium and long term that must be carried out for the conservation of these species, determining indicators of success.

c. Establish a working group for the management and conservation of sharks and rays within of anp, that includes all the actors involved.

STRATEGIC AXES AND LINES

1. COMPREHENSIVE HABITAT MANAGEMENT

Objective: To establish strategies for the management of the habitat of sharks and rays under a landscape ecology approach, considering aspects of regional connectivity and processes. ecological systems on a large scale, through instruments and mechanisms that ensure the conservation of species and their function within the ecosystem.

1.1. Habitat Protection Component - Actions that contribute to protection shark and ray habitat through various schemes or modalities of conservation.

1.1.1. Implement dissemination campaigns aimed at PA users on the regulations on waste and protection of the marine habitat.

1.1.2. Integrate a comprehensive maritime spatial planning scheme that strengthens the zoning of the

marine polygons of the anp, and that recognizes areas critical to elasmobranch development.

1.1.3. Install signs within the polygons of anp that seek to prevent damage to the marine habitat due to stranding, pollution or other nautical contingencies.

1.1.4. Promote the development of official nautical charts for the polygons of anp's marinas, in collaboration with SEMAR.

1.1.5. Promote the designation of anp's that contain reef areas, as areas sensitive to navigation.

1.1.6. Promote the use of conservation criteria for essential habitats and critics of sharks and rays in urban planning processes and coastal related anp.

1.2. Restoration Component - Actions aimed at initiating or accelerating the recovery of the habitat of the species with respect to its health, integrity and sustainability, with a landscape ecology approach

1.3. Connectivity Component - Actions that strengthen the conservation of biological corridors and ANP complexes as a strategy to conserve migratory habitat and connectivity of shark and ray populations.

1.3.1. Promote the integral management of hydrographic basins, taking into account requirements of each site, in an interdisciplinary, multisectoral and interinstitutional.

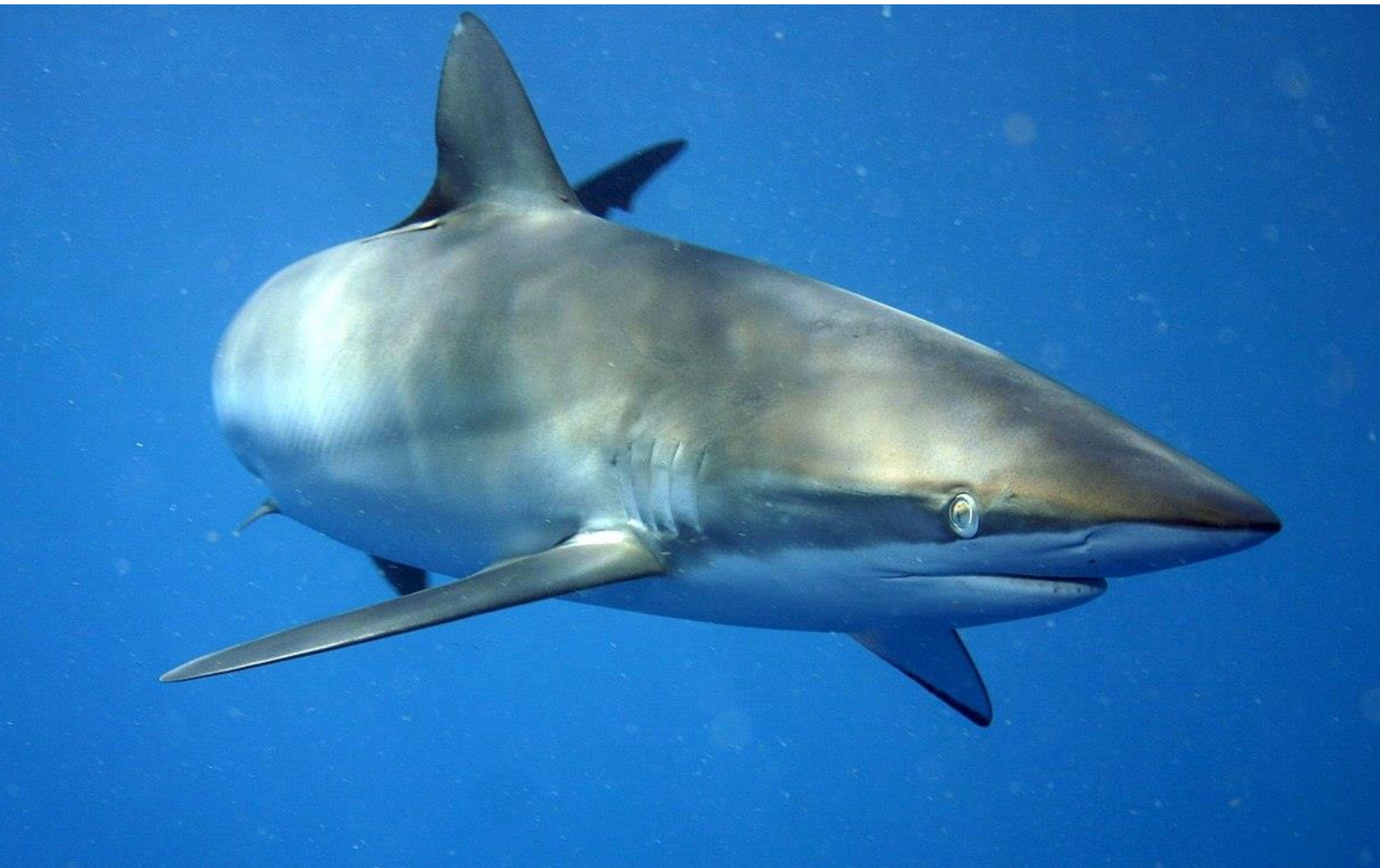
1.3.2. Promote the exchange of information with foreign researchers specializing in elasmobranchs, to define migratory corridors and connectivity components in the habitat.

1.3.3. Implement satellite and / or acoustic marking programs for highly migratory species, to learn about their distribution, connectivity between priority areas, characterize their habitat use and identify habitat essential.

2. Conservation and Management of Species

Objective: To develop actions for the recovery of populations of sharks and rays in anp, involving the





participation of all relevant stakeholders for its conservation.

2.1. Protection and Surveillance Component - Carrying out coordinated actions to the protection, management and monitoring of shark and ray populations in anp.

2.1.1. Implement an intersectoral collaboration scheme in conjunction with the fishing sector and SEMAR, to reinforce the inspection and surveillance actions of authorized fishing activities within polygons of anp.

2.1.2. Promote the use of new technologies that facilitate inspection work and surveillance in the marine polygon of anp.

2.1.3. Implement an inspection and surveillance program that involves the participation of coastal communities related to the anp with polygons marine.

2.1.4. Promote the implementation of coordinated surveillance actions in the field of tourism and urban development involving the three levels of government, to protect critical areas for elasmobranch development.

2.2. Impact Prevention Component - Actions aimed at preventing the negative impacts of anthropogenic activities on elasmobranch populations and its habitat in anp.

2.2.1. Prepare specific contingency plans for anp's with a marine polygon for oil spills, groundings and other nautical contingencies that alter the habitat of sharks and rays.

2.2.2. Generate guidelines for the proper maintenance of boats fishing or tourist companies that operate within the anp's polygon, which include specific sanctions for those who fail to comply.

2.3. Population Management Component - Management actions aimed at the recovery and maintenance of shark and ray populations in anp.

2.3.1. Work together with the fishing sector to carry out a management of the fishing for sharks and rays within polygons of anp, which you specify with clarify the fishing areas in the permits and avoid the use in breeding and rearing areas.

2.3.2. Collaborate with the fishing sector to adopt measures to reduce the bycatch of elasmobranchs in artisanal fisheries authorized to be carried out within the polygons of anp.

2.4. Actors Coordination Component - Actions that promote coordination effective between the instances of the federal public administration, state governments and municipalities, academia and social organizations for the conservation of species of sharks and rays in anp.

2.4.1. Promote collaboration and coordination actions between conanp and the cites authorities (Scientific and Administrative) for the dissemination of identification of species of sharks and rays recently included in Appendix II and procedures for obtaining citations authorizations between interested fishers' organizations operating within polygons of anp. **2.4.2.** Hold meetings between the different authorities to coordinate actions supervision, inspection and surveillance, with periodic evaluation of the results obtained.

2.4.3. Prepare a regulation for the verification of "friendly" practices to elasmobranchs by tourism service providers in anp, in coordination with the various related institutions.

2.4.4. Promote frequent updating of the National Fisheries Charter with the most recent technical and scientific information.

2.5. Research and Monitoring Component - Actions for the generation of knowledge focused on the management of shark and ray species, which supports the decision making for conservation.

2.5.1. Develop a Geographic Information System that describes the types of habitat provided by ANPS to elasmobranchs, from the perspective of their essential habitat (reproduction, nurture, food and protection), which supports management and subzonin decisions.

2.5.2. Promote studies that identify areas for the birth and breeding of sharks and rays within anp, in order to prioritize their protection.

2.5.3. Carry out load capacity studies for both maritime traffic and for tourist activities that could affect elasmobranchs within of anp.



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2.5.4. Carry out, in collaboration with the fishing sector, research and transfer of technology for the improvement of fishing gear that provide greater efficiency and selectivity to the use of sharks and rays within anp.

2.5.5. Promote studies on the abundance and condition of shark stocks and stripes in anp, which provide relevant information to implement better sustainable management and use measures.

2.5.6. Implement a landing information collection strategy at the species level of sharks and rays captured within anp, with the in order to have the necessary data to feed dynamics models population.

2.5.7. Develop scientific studies that identify the effects of development shoreline in critical and essential shark and ray habitats.

2.5.8. Strengthen and guarantee the continuity of observer programs to board and discharge monitoring during elasmobranch fishing in anp, with coordinated actions between conanp and the fishing sector.

2.5.9. Carry out, in coordination with the fishing sector, studies on the levels of bycatch of elasmobranchs in scale fisheries conducted within the polygons of anp.

3. SOCIAL PARTICIPATION AND CULTURE FOR CONSERVATION

Objective: To promote the co-responsible participation of society in the conservation of shark and ray species and their habitats, promoting culture and strengthening capacities of the communities regarding said conservation.

3.1. Culture Component - Actions that promote education, communication and dissemination on the importance of shark and ray conservation.

3.1.1. Implement programs to disseminate regulations related to sharks and rays among all stakeholders within the anp

3.1.2. Carry out an awareness campaign to avoid damage to the habitat due to negligence during nautical operations.

3.1.3. Implement Environmental Education programs for the dissemination of the ecological importance of sharks and rays within anp.

3.1.4. Promote an education and awareness campaign on the effects of hydrographic basin in the ecology of the anp with a marine component.

3.2. Component Social Participation and Training - Actions that promote the involvement of communities in shark conservation actions and rays, strengthening their technical and managerial capacities.

3.2.1. Encourage the involvement of the different actors to comply with the regulations regarding the conduct of prospective studies for mining and extraction of hydrocarbons in areas close to marine areas.

3.2.2. Implement training programs on navigation areas to prevent nautical contingencies that alter the marine habitat.

3.2.3. Implement a training program for tourism service providers that operate within anp, to avoid harmful practices to sharks and stingrays, and their habitat.

3.2.4. Implement a training program for fishermen to understand the regulations associated with the sustainable use of sharks and stripes inside anp's.

3.2.5. Carry out training workshops aimed at officials and members of the environmental gendarmerie on the application of the legal framework related to sustainable use of sharks and rays.

4. CONSERVATION ECONOMICS

Objective: Contribute to the strengthening and consolidation of sustainable productive activities that promote the conservation of elasmobranch species and that contribute to the reduction of poverty and marginalization in the areas where they are distributed.

4.1. Sustainable Economic Alternatives Component - Actions that contribute to the strengthening and consolidation of productive activities that promote conservation of shark and ray species.

4.1.1. Promote the implementation of sustainable economic activities and productive diversification in support of the communities that inhabit the coastal ANP.



4.1.2. Promote that the development of tourist and urban infrastructure is sustainable, economically, socially and ecologically.

4.2. Biodiversity Valuation Component - Actions that promote the valuation of the goods and services obtained from the conservation of species of elasmobranchs and their habitat.

4.2.1. Promote, in coordination with the fishing sector, awareness campaigns on alternatives for national consumption of fishing resources whose populations are in a good state of conservation.

4.2.2. Promote an education campaign for the population, promotion of transparency and ethical and responsible performance of public functions and developers regarding the goods and services obtained from the conservation of sharks.

4.3. Economic Instruments for Conservation Component - Actions to implement economic and financial instruments for the conservation of shark and ray species in coordination with other actors and sectors.

4.3.1. Promote and generate mechanisms for the certification of sustainable fisheries for sharks and rays within hna polygons, based on certification experiences in operation at an international level.

4.3.2. Evaluate and where appropriate avoid adverse subsidies, instead strengthening those that contribute to the sustainable use of sharks and rays in anp.

4.4. Sustainable Use Component - Actions that contribute to the strengthening of activities for the sustainable use of sharks and rays.

4.4.1. Promote social organization and training in community groups of interest that inhabit protected natural areas and that take advantage of the sharks and rays as a way of life, so that they adopt sustainable use practices.

II. COORDINATION AND SUPPORT AXES

5. Coordination of Intersectoral and Multilevel Policies

Objective: Achieve articulation with the three levels of government, national institutions and international and with society in a framework of coordination, linkage, transversality

and synergy in public policies and the regulatory framework, which considers ecosystems and goods and services as pillars of sustainable development.

5.1. Issue recommendations for good intersectoral coordination between entities fisheries and environmental activities related to the sustainable use of elasmobranchs in anp.

5.2. Generate intersectoral synergies for monitoring, inspection and surveillance standardized.

5.3. Promote that public policies for tourism development are compatible with the conservation and management of Rays and Sharks.

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