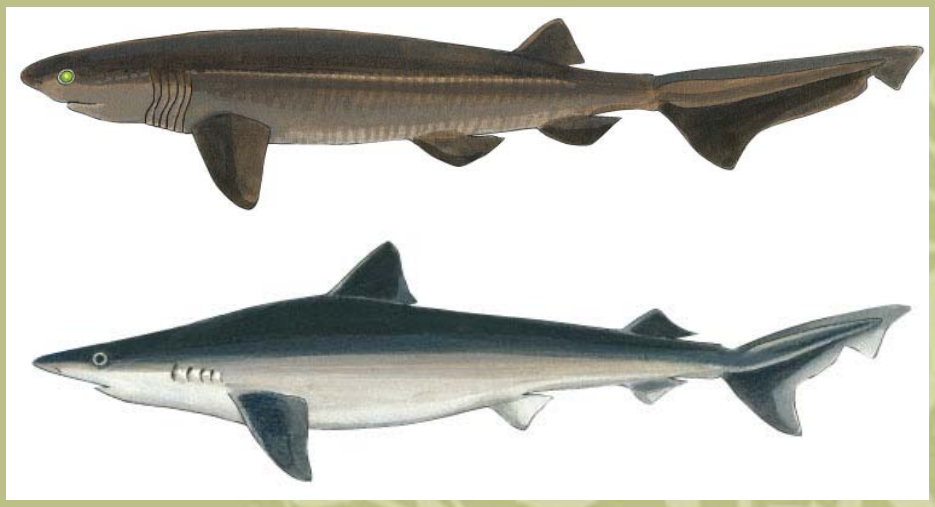
PROPOSED

Species at Risk Act
Management Plan Series

Management Plan for the Bluntnose Sixgill Shark (*Hexanchus griseus*) and Tope Shark (*Galeorhinus galeus*) in Canada

Bluntnose Sixgill Shark and Tope Shark



January 2012

Fisheries and Oceans Canada
Pêches et Océans Canada
Canada

About the *Species at Risk Act* Management Plan Series

What is the *Species at Risk Act* (SARA)?

SARA is the Act developed by the federal government as a key contribution to the common national effort to protect and conserve species at risk in Canada. SARA came into force in 2003, and one of its purposes is "*to manage species of special concern to prevent them from becoming endangered or threatened*."

What is a species of special concern?

Under SARA, a species of special concern is a wildlife species that could become threatened or endangered because of a combination of biological characteristics and identified threats. Species of special concern are included in the SARA List of Wildlife Species at Risk.

What is a management plan?

Under SARA, a management plan is an action-oriented planning document that identifies the conservation activities and land use measures needed to ensure, at a minimum, that a species of special concern does not become threatened or endangered. For many species, the ultimate aim of the management plan will be to alleviate human threats and remove the species from the List of Wildlife Species at Risk. The plan sets goals and objectives, identifies threats, and indicates the main areas of activities to be undertaken to address those threats.

Management plan development is mandated under Sections 65–72 of SARA (http://www.sararegistry.gc.ca/approach/act/default_e.cfm).

A management plan has to be developed within three years after the species is added to the List of Wildlife Species at Risk. Five years is allowed for those species that were initially listed when SARA came into force.

What's next?

Directions set in the management plan will enable jurisdictions, communities, land users, and conservationists to implement conservation activities that will have preventative or restorative benefits. Cost-effective measures to prevent the species from becoming further at risk should not be postponed for lack of full scientific certainty and may, in fact, result in significant cost savings in the future.

The series

This series presents the management plans prepared or adopted by the federal government under SARA. New documents will be added regularly as species get listed and as plans are updated.

To learn more

To learn more about the *Species at Risk Act* and conservation initiatives, please consult the SARA Public Registry (http://www.sararegistry.gc.ca/)

Management Plan for the Bluntnose Sixgill Shark (*Hexanchus griseus*) and Tope Shark (*Galeorhinus galeus*) in Canada

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Additional copies:

Additional copies can be downloaded from the SARA Public Registry (http://www.sararegistry.gc.ca/).

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PREFACE

The Bluntnose Sixgill Shark and Tope Shark are marine fish and are under the responsibility of the federal government. The *Species at Risk Act* (SARA, Section 65) requires the competent ministers to prepare management plans for species listed as Special Concern. The Bluntnose Sixgill Shark and Tope Shark were listed as species of special concern under SARA in 2009. The development of this management plan was led by Fisheries and Oceans Canada – Pacific Region, in cooperation and consultation with many individuals, organizations and government agencies, as indicated below. The plan meets SARA requirements in terms of content and process (SARA sections 65-68).

Success in the conservation of this species depends on the commitment and cooperation of many different constituencies that will be involved in implementing the directions set out in this plan and will not be achieved by Fisheries and Oceans Canada, Parks Canada Agency, or any other party alone. This plan provides advice to jurisdictions and organizations that may be involved or wish to become involved in activities to conserve this species. In the spirit of the Accord for the Protection of Species at Risk, the Minister of Fisheries and Oceans and the Minister responsible for the Parks Canada Agency invite all responsible jurisdictions and Canadians to join in supporting and implementing this plan for the benefit of the Bluntnose Sixgill Shark and Tope Shark and Canadian society as a whole. The Ministers will report on progress within five years.

RESPONSIBLE JURISDICTIONS

Fisheries and Oceans Canada
Parks Canada Agency

AUTHORS

The 2010-2011 Bluntnose Sixgill Shark and Tope Shark Technical Team developed this management plan for Fisheries and Oceans Canada. Section 5 lists technical team members.

ACKNOWLEDGMENTS

Fisheries and Oceans Canada (DFO) would like to thank Gordon (Sandy) McFarlane for assisting in the development of this management plan. Heather Brekke from DFO Ecosystem Management Branch, Adam Keizer from DFO Groundfish Management Unit, Jackie King and Romney McPhie from DFO Science, and Jennifer Yakimishyn from Parks Canada Agency provided valuable advice and document review. Further, DFO would like to acknowledge all who participated in the Bluntnose Sixgill Shark and Tope Shark Management Plan Technical Workshop (participants are listed in Appendix I). The workshop proceedings provided valuable scientific and technical advice, which supported the completion of this management plan.

STRATEGIC ENVIRONMENTAL ASSESSMENT

A strategic environmental assessment (SEA) is conducted on all SARA recovery planning documents, in accordance with the *Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals*. The purpose of a SEA is to incorporate environmental considerations into the development of public policies, plans, and program proposals to support environmentally-sound decision making.

Recovery planning is intended to benefit species at risk and biodiversity in general. However, it is recognized that plans may also inadvertently lead to environmental effects beyond the intended benefits. The planning process based on national guidelines directly incorporates consideration of all environmental effects, with a particular focus on possible impacts on non-target species or habitats. The results of the SEA are incorporated directly into the plan itself, but are also summarized below.

This management plan will clearly benefit the environment by promoting the conservation of the Bluntnose Sixgill Shark and Tope Shark. The potential for the plan to inadvertently lead to adverse effects on other species was considered. The SEA concluded that this plan will clearly benefit the environment and will not entail any significant adverse effects. Measures to conserve the Bluntnose Sixgill Shark and Tope Shark from effects of threats will likely have positive benefits for the conservation of other marine species. Further, efforts to promote the conservation of these species will likely result in increased data on other shark and marine species as well as on oceanographic processes. The reader should refer to the following sections of the document in particular: Habitat and biological needs; Ecological role; Limiting factors; and Actions.

EXECUTIVE SUMMARY

The Bluntnose Sixgill Shark (*Hexanchus griseus*) and Tope Shark (*Galeorhinus galeus*) are marine fish which were both listed as species of "special concern" under the *Species at Risk Act* (SARA) in March 2009. This followed the 2007 assessment of both species as "special concern" by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

The Bluntnose Sixgill Shark is an opportunistic predator widely distributed throughout temperate and tropical seas around the world. It is likely well distributed within a wide depth range (surface to 2500 m) throughout much of Canadian Pacific waters including inlets, continental shelf and slope waters, and the Strait of Georgia. Age of maturity is estimated to be 11-14 years for males and 18-35 years for females, with an estimated longevity of up to 80 years, and a maximum length of 350 cm (males) and 480 cm (females). Current abundance in Canadian Pacific waters is unknown.

The Tope Shark, also known as the Soupfin Shark, is an opportunistic predator found throughout temperate and subtropical seas between 68°N - 55°S latitude. In Canadian Pacific waters, it is primarily found in continental shelf waters within the depth range of surface to 471 m along Vancouver Island, Queen Charlotte Sound, and Hecate Strait. Records have shown that Tope in these waters are predominantly adult males. Age of maturity is estimated to be 12-17 years for males and 13-15 years for females, with an estimated longevity of at least 45 years, and a maximum length of 175 cm (males) and 195 cm (females). Current abundance in Canadian Pacific waters is unknown.

Limiting factors are natural processes that limit population size or growth, whereas threats (both natural and anthropogenic) have caused, are causing, or may cause harm, death or behavioural changes to a species at risk or the destruction, degradation and/or impairment of its habitat to the extent that population level-effects occur. The Bluntnose Sixgill Shark and Tope Shark are limited by bottom-up and top-down processes that affect their intrinsic rate of increase, prey availability, recruitment success, and mortality rates.

The primary threats identified for these species are entanglement and bycatch. Other threats identified include pollution, habitat loss or degradation, climate and oceanographic change, and harassment. Historic threats included directed fisheries and entanglement/bycatch. While these populations are migratory throughout the northeast Pacific, it is unknown whether threats occurring outside of Canadian Pacific waters have an impact on these populations.

The management goal for the Bluntnose Sixgill Shark and Tope Shark is to maintain their abundance within Canadian Pacific waters at current or higher levels. Management objectives and resulting actions have been identified in this plan to support the management goal. Table 6 summarizes those actions that are recommended to support the management goals and objectives. The activities implemented by Fisheries and Oceans Canada will be subject to the availability of funding and other required resources.

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1. SPECIES INFORMATION

1.1. Species Assessment Information from COSEWIC

1.1.1. Bluntnose Sixgill Shark COSEWIC Assessment Information

Date of Assessment: April 2007

Common Name (population): Bluntnose Sixgill Shark

Scientific Name: *Hexanchus griseus*

COSEWIC Status: Special Concern

Reason for Designation: This large (maximum reported length 4.8 m), heavy-bodied shark is a benthic species that is widely distributed over continental and insular shelves in temperate and tropical seas throughout the world. In Canadian Pacific waters, it is found in inlets and along the continental shelf and slope typically at depths greater than 91 m (range 0-2500 m). In the absence of information about population structure, it is treated as a single population for assessment purposes. The present population size and abundance trends are not known. The only available abundance index, encounter rates with immature sharks at a shallow site in the Strait of Georgia, has decreased significantly (>90%) in the last five years. This index is not likely representative of the overall abundance trend because only immature sharks are encountered and the site is shallow relative to the preferred depth range. The principal known threat to the species is fishing. This shark has been the focus of at least three directed fisheries in Canadian waters, most recently in the late 1980s and early 1990s. It continues to be caught as bycatch, but survival of released sharks is unknown. Sharks observed by divers sometimes show scars from entanglement in fishing gear. Because of this late age of maturity (18-35 yr for females), it is likely susceptible to overfishing even at low levels of mortality. Little is known about the abundance and movement patterns of this species elsewhere in the world, so the potential for a rescue effect is unknown.

Canadian Occurrence: Pacific Ocean

COSEWIC Status History: Designated Special Concern in April 2007. Assessment based on a new status report.

1.1.2. Tope COSEWIC Assessment Information

Date of Assessment: April 2007

Common Name (population): Tope

Scientific Name: *Galeorhinus galeus*

COSEWIC Status: Special Concern

Reason for Designation: This Pacific coast shark is thought to be highly migratory across its range from Hecate Strait, BC to the Gulf of California. Tope shows no evidence of distinct populations and thus for the purposes of this assessment is considered a single population. It feeds primarily on fish, and in Canada occupies continental shelf waters between western Vancouver Island and Hecate Strait. Maximum length is less than two metres, maximum age is at least 45 years, maturity between 12 and 17 years, and generation time 23 years. Tope is noted for its high concentration of liver Vitamin A, exceeding that of any other north-east Pacific fish species. Demand for vitamin A during World War II led to a large fishery that quickly collapsed due to over-exploitation. More than 800,000 individuals, primarily large adults, were killed for their livers between 1937 and 1949 throughout its migratory range. Tope is rarely seen today in Canadian waters. There is no targeted commercial fishery in Canada, but it continues to be caught as fishery bycatch in Canada and the U.S., and remains the target of small commercial and recreational fisheries in the U.S. Because there is no population estimate for tope, the sustainability of current catches cannot be assessed. The ongoing fishery mortality, the lack of a management plan for Canadian bycatch, and the long generation time and low fecundity of tope suggest cause for concern.

Canadian Occurrence: Pacific Ocean

COSEWIC Status History: Designated Special Concern in April 2007. Assessment based on a new status report.

1.2. Description

1.2.1. Description of the Bluntnose Sixgill Shark

The Bluntnose Sixgill Shark (*Hexanchus griseus*) is one of four species belonging to the family Hexanchidae sometimes referred to as cow sharks. The Bluntnose Sixgill Shark is easily recognizable with characteristics not often found in other shark species (Mecklenburg *et al.* 2002), such as the presence of six gill slits as well as a single dorsal fin (all other shark species found in Canadian Pacific waters, with the exception of the Broadnose Sevengill Shark (*Notorynchus cepedianus*), have a second dorsal fin). It is dark brown or grey to black dorsally becoming lighter towards its underside. The head is broad and depressed with a blunt snout. The single dorsal fin is located far back on the body and positioned above and in between the pelvic

and anal fins on the ventral side. Like many benthic sharks, the caudal fin of the Bluntnose Sixgill Shark has a small lower lobe.

The Bluntnose Sixgill Shark is yolk-sac viviparous (the young hatch within the female's body before being released), and produce litters estimated to range from 47-108 pups which are 61 to 73 cm in size (Ebert 2002, 2003). This species is sexually dimorphic with females growing larger than males. Maximum length has been reported at 350 cm and 480 cm for males and females respectively. Length at maturity is reported at 421 cm for females and 310 cm for males (Ebert 2002). Age of maturity is estimated to be 11-14 years for males and 18-35 years for females, with an estimated longevity of up to 80 years (Florida Museum of Natural History 2010), although these estimates have not been validated.

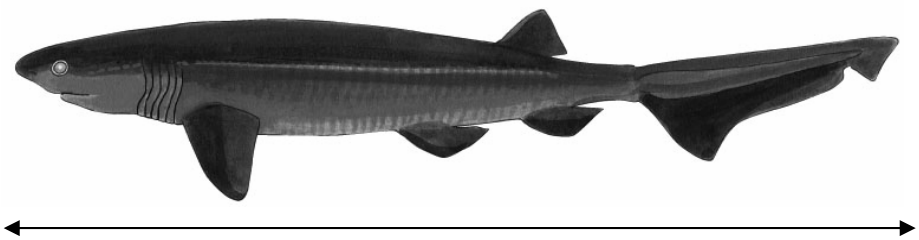

Figure 1. Illustration of the Bluntnose Sixgill Shark (DFO, 2011).

1.2.2. Description of the Tope Shark

The Tope Shark (*Galeorhinus galeus*), also known as the Soupfin Shark, is one of 46 species belonging to the family Triakidae (Houndsharks). The Tope Shark is the only representative from the family Triakidae on Canada's Pacific coast. The Tope Shark is dark bluish gray on its dorsal side which shades to white on the underside (Mecklenburg *et al.* 2002). It has two dorsal fins, with the first dorsal fin well ahead of the pelvic fins and the second dorsal fin being about the same size as the anal fin. The caudal fin has a large subterminal lobe which is nearly as long as the lower lobe (Ebert 2003). The snout is long and pointed with a large mouth. The eyes of the Tope Shark are horizontally oval with conspicuous spiracles behind each eye.

The genetic structure of Tope Shark in the Northeast Pacific is unknown, and no studies have been conducted on age and growth of the Tope Shark. Recent molecular studies (Chabot and Allen, 2009) found significant genetic structure within global populations of Tope Shark globally, and little to no gene flow between geographic regions, suggesting that there may be subspecies, or distinct regional species, within this genus. However, further studies are required to validate this, and for the purpose of this management plan, the Tope Shark is assumed to be one species.

Little is known about the breeding behaviour of the Tope Shark. The Tope Shark is yolk-sac viviparous, with the female carrying between 6 and 52 pups released between March and July (Compagno 1984; Ebert 2003), averaging 35-37 cm long (Ripley 1946). The Tope Shark exhibits rapid growth during the first three years followed by steady growth until about 10 years of age, and then slow continued growth through maturity. In the northeast Pacific maximum length of

females is 195 cm, for males is 175 cm (Compagno 1984). Tope Shark are slow growing and reach a maximum age of at least 45 years. Age of maturity in females is estimated to be about 13-15 years and males at about 12-17 years (Francis and Mulligan 1998). In eastern Pacific waters, females are mature at 150 cm total length and males are mature at 135 cm.

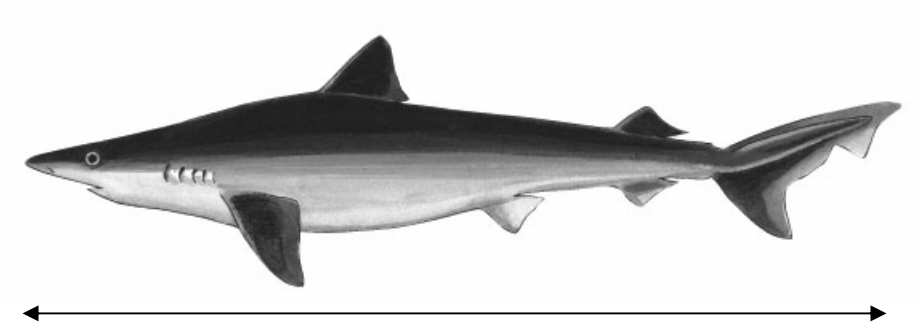

Figure 2. Illustration of the Tope Shark (DFO, 2011).

1.3. Populations and Distribution

1.3.1. Population and Distribution of the Bluntnose Sixgill Shark

Bluntnose Sixgill Sharks are widely distributed throughout temperate and tropical seas around the world (Figure 3). In the north Pacific, they can be found from Japan, south of the Aleutian Islands, to California and Mexico as well as the Hawaiian Islands (Compagno 1984; Mecklenburg *et al.* 2002). In the south Pacific, they are reported from Australia and New Zealand. In the western Atlantic Ocean, its range is from North Carolina to Florida and from the northern Gulf of Mexico to northern Argentina including Nicaragua, Costa Rica, and Cuba. In the eastern Atlantic, this shark is found from Iceland and Norway to South Africa, including the Mediterranean Sea. Its range in the Indian Ocean includes waters off Madagascar and Mozambique. In 2005, the IUCN Red List assessed Bluntnose Sixgill Shark as globally Near Threatened (Cook & Compagno 2005). There is no information available to estimate global abundance of Bluntnose Sixgill Sharks, though the IUCN Red List indicates the global population trend is decreasing.

Figure 3. Known global distribution of Bluntnose Sixgill Sharks (Cook & Compagno 2005).

The Bluntnose Sixgill Shark is likely well distributed throughout much of Canadian Pacific waters including inlets, continental shelf and slope, and the Strait of Georgia. Recorded observations available in databases are limited to recent commercial catch records (1979-2007) and research surveys for other species and therefore do not fully describe their Canadian range (Figure 4). The trawl fleet captures this species over a wide range of depths (20-1000 m) with the number of captures being proportional to effort with no particular preferred depth range. The hook and line fleet has encountered this species between 20 and 440 m with most observations less than 200 m. Intensive fishing for this species took place in the late 1930s to mid-1940s but otherwise catch has been limited to bycatch. Migratory behaviour on a seasonal and/or latitudinal basis in the northeast Pacific is limited; however a recent study (Andrews *et al.* 2010) reported that Bluntnose Sixgill Sharks tagged in Puget Sound with acoustic transmitters moved seasonally to the north from winter to spring, and to the south from summer to fall. Further, this study described two of these tagged sharks moved north as far as Queen Charlotte Strait and the north west coast of Vancouver Island, British Columbia, and another shark moved south as far as Pt. Reyes, California. Overall, movement patterns are characterized by a bathymetric migration of mature individuals to shallower, nearshore nursing areas (depths <200m) to give birth (Ebert 2002, 2003). Juveniles appear to utilize coastal waters in inlets along the west coast of Vancouver Island, the Strait of Georgia and Puget Sound, and have extended residency in these relatively small areas (COSEWIC 2007a; Dunbrack and Zielinski 2003; Andrews *et al*. 2007). Migratory behaviour on a seasonal and/or latitudinal basis is unknown.

There are presently no reliable indicators for understanding Bluntnose Sixgill Shark abundance in Canadian Pacific waters. An abundance estimate based on genetic techniques suggests a minimum breeding population in the northeast Pacific at ~7900 individuals (Larson *et al*.2005). This estimate is considered unlikely to be accurate (COSEWIC 2007a) due to small sample size. A second index of abundance measured encounter rates of immature Bluntnose Sixgill Sharks at a single shallow site (40m) in the Strait of Georgia (Dunbrack and Zielinkski 2003). This index

suggested a decline of at least 90% in the abundance of immature Sixgill sharks over five years. However, this index does not represent overall abundance since it is limited to immature sharks at a single shallow site (40m) relative to the species preferred depth range. Further, individual sharks are typically not identifiable and thus the index may not record abundance but rather behaviour at the site. Due to the use of one surveillance site which is atypical in nature (i.e., that Bluntnose Sixgill Sharks can be observed regularly in shallow waters), interpretations made from this observation trend must be viewed with caution. It is unlikely, even under the assumption that mortality to Bluntnose Sixgill Sharks has increased, that this mortality would be enough to account for the suggested rate of decline from this site. Other plausible explanations include a change in environmental conditions, such as water temperature, that may influence the bathymetric distribution of the sharks. In 2004 the temperature at 10 meters was the second highest annual temperature recorded since 1970, and at bottom depths (395 m) was the warmest on record (DFO 2006). This warm trend persisted through to 2007, and then declined in 2008 (Beamish et al. 2010). It is possible that these observed differences in temperatures extended northwards to the Flora Islet site thereby influencing the video encounter rates of Bluntnose Sixgill Sharks at Flora Islet.

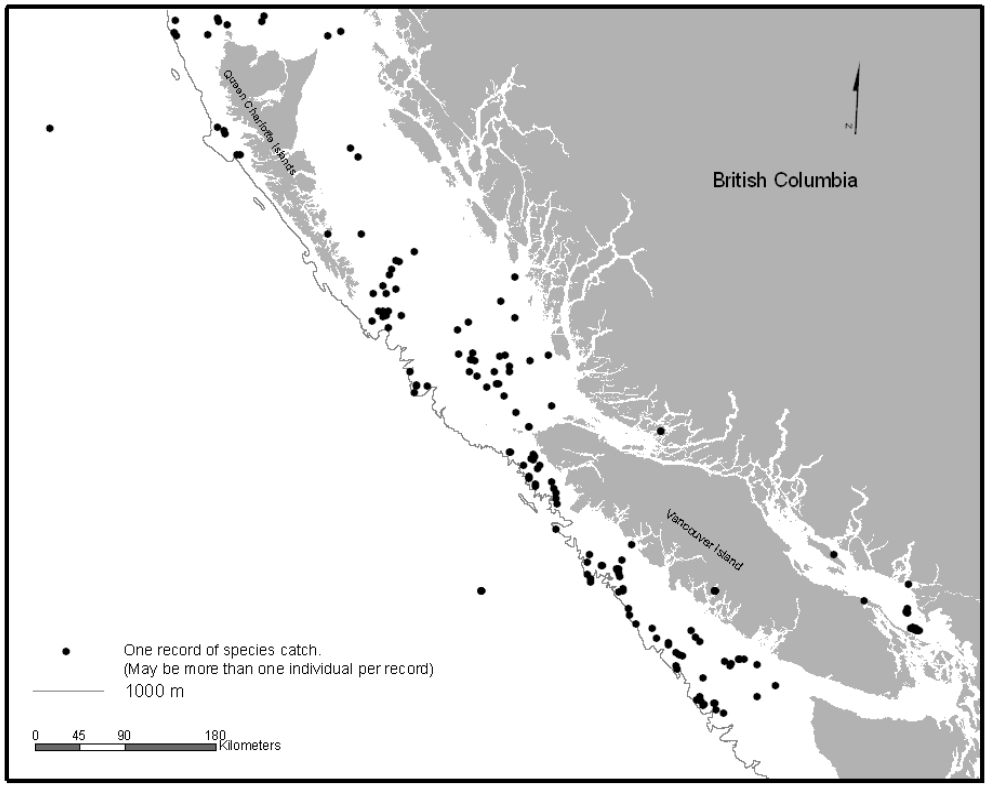

Figure 4. Distribution of catches of Bluntnose Sixgill Shark (Hexanchus griseus) off the west coast of Canada from 1979 to 2007. Positional data of catches retrieved from fisheries and research databases at the Pacific Biological Station (GFCatch; PacHarvTrawl; PacHarvHL; PacHar3; GFBio).

1.3.2. Population and Distribution of the Tope Shark

The Tope Shark occurs in temperate and subtropical seas between 68°N - 55°S latitude (Figure 5). Tope Shark are found in the eastern Pacific from northern British Columbia (no records from Alaska) to the Gulf of California as well as waters off Peru and Chile. Migration of this species in eastern Pacific waters is poorly understood; limited tagging of this species in eastern Pacific waters (Ripley 1946; Herald and Ripley 1951) has shown mixing across the range from southern California to British Columbia. Given the high mobility of Tope shark, interchange is probable, at a minimum, between waters off British Columbia, the western U.S. and Baja Peninsula, Mexico. Tope Shark are distributed in the southwestern Pacific Ocean in waters off Australia and New Zealand. In the western Atlantic Ocean, its range is limited from southern Brazil to Argentina while in the eastern Atlantic it can be found from Iceland to South Africa, including the Mediterranean Sea. In the western Indian Ocean region, the Tope Shark can be found in waters off South Africa (Compagno 1984). In 2006, the IUCN Red List assessed Tope Shark as globally vulnerable, and within the Eastern North Pacific as Least Concern (Walker *et al.* 2006). There is no information available to estimate global abundance of Tope Shark.

Figure 5. Known global distribution of Tope Shark (red shaded areas) (Walker *et al*. 2006).

In Canadian Pacific waters, records for Tope Shark occur primarily from continental shelf waters along Vancouver Island, Queen Charlotte Sound, and Hecate Strait. There are no known research or commercial fishing records of Tope Shark being taken from the Strait of Georgia (Figure 6). Based on commercial trawl data between 1996 and 2005, 95% of catches of Tope shark (n=109 sets with Tope Shark) fall between the depths of 47-285 m. The area between these two depths off Canada's west coast is ~73,600 km^2 which can be considered the extent of probable occurrence in Canadian Pacific waters. Movement patterns of Tope Sharks in the northeast Pacific are poorly understood. There appears to be both bathymetric and latitudinal movements that vary by both sex and season. Off the west coast of North America males are dominant in northern latitudes and females dominant in southern latitudes (Ripley 1946). In recent research

surveys (2002-2009) in Canadian Pacific waters 84% of Tope shark captured (n=19) were male (King pers. comm. 2011). Tagging studies in other areas of the world suggest that at least some component of the population undergoes extended migrations and that these sharks are capable of traveling long distances over a short period of time (COSEWIC 2007b).

Current abundance and population trends for the Tope Shark in Canadian Pacific waters are unknown. There are no indices of Tope Shark abundance within their northeastern Pacific range. Walker (1999) reported that between 1938 and 1944 approximately 15,600 t of Tope Shark were estimated to have been removed from waters along the west coast of North America (COSEWIC 2007b). This catch can be used as a surrogate for a minimum historic population. Present day population biomass is unknown. Given sixty years of no targeted fishing for Tope Shark, minimal bycatch, and its fecundity rates, it is reasonable to assume a population recovery to at least 10% of the historical level. At this level, at least 1,500 t are present along the west coast of North America.

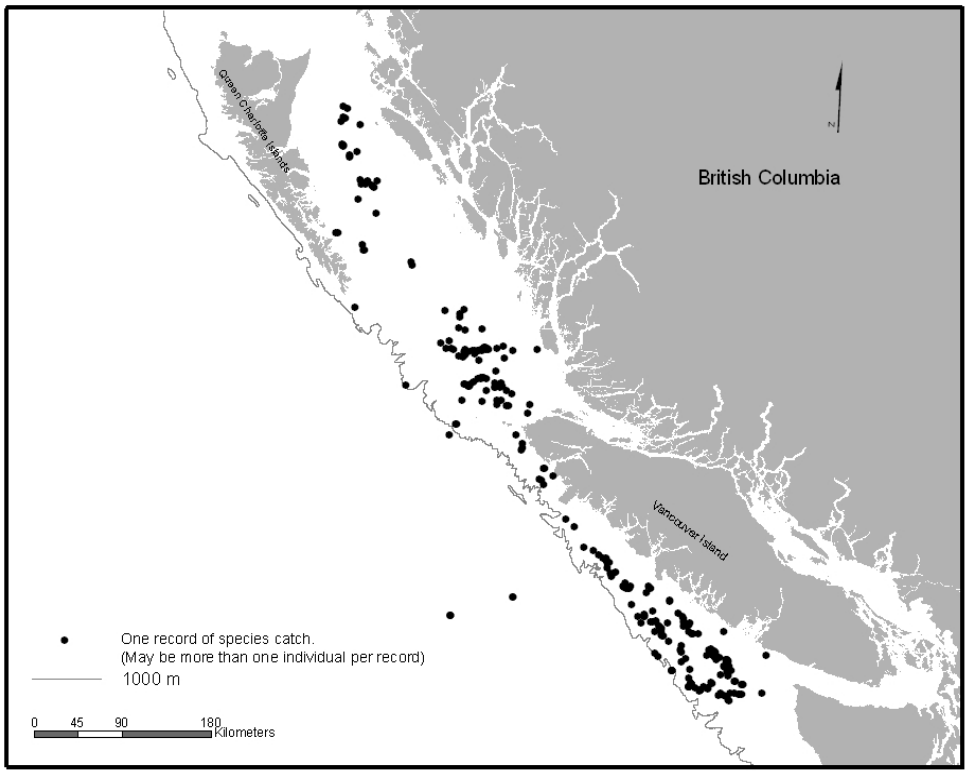

Figure 6. Distribution of catches of Tope Shark (Galeorhinus galeus) off the west coast of Canada from 1994 to 2007. Positional data of catches retrieved from fisheries and research databases at the Pacific Biological Station (GFCatch; PacHarvTrawl; PacHar3 GFBio).

1.4. Needs of the Species

1.4.1. Habitat and biological needs of the Bluntnose Sixgill Shark

The Bluntnose Sixgill Shark is considered to be primarily a deepwater benthic species found in waters below 91 m, but is known to occur from the surface to depths of 2,500 m (Ebert 2003).

They are often found over the outer continental and insular shelves as well as upper slopes associated with areas of upwelling and high biological productivity (Ebert 2003). Some adults occasionally migrate to shallower waters (Andrews *et al.* 2007). Two instances of mature females (with pups) stranded in shallow waters of Puget Sound and the Strait of Georgia have been recorded (Williams *et al.* 2010; King, pers. comm. 2011) suggesting that mature females migrate to shallow waters to give birth. Newborn pups and juveniles are thought to remain in shallower waters of the continental shelf and uppermost slope until they reach adolescence, at which time they move further down the slope and into deeper water (Ebert 2003). In British Columbia, a single tagging study (n=214) was carried out in 1994 in inlets along the west coast of Vancouver Island found primarily juveniles of both sexes with no mature females and a mean length of both sexes of 205 cm (McFarlane pers. comm. 2011). A video surveillance study in the Strait of Georgia conducted in 2001-2002 also observed only immature animals with a mean length of 240 cm (n=35) (Dunbrack and Zielinski 2003). Similar studies in Puget Sound encountered only juvenile fish (Andrews *et al*. 2007). Using an array of automated acoustic receivers to monitor movement patterns of juveniles in Puget Sound they reported relatively small daily movements of < 3.1 km and a maximum displacement over the entire study period (September 2004 - February 2005) of 23 km. These studies have led to speculation that these inshore areas of Puget Sound, Strait of Georgia and West Coast Vancouver Island inlets may represent important Bluntnose Sixgill Shark nursery grounds.

1.4.2. Habitat and biological needs of the Tope Shark

The Tope Shark is considered a coastal pelagic species, often found well offshore but not oceanic (Compagno 1984). Their habitat is described as temperate continental shelf waters ranging from close inshore, including shallow bays, to offshore waters up to 471 m depth, often near the bottom (Ebert 2003). They have been found in the surfline, as well as in bays and submarine canyons. Offshore, they are generally thought to occur near the bottom but have been captured by pelagic floating longlines over deep waters (Compagno 1984). Pups and juveniles utilize shallow nearshore habitats for one to two years before moving offshore. It is believed the Southern California Bight is the main nursery area for this species (Ebert pers. comm. 2011).

1.4.3. Ecological role of the Bluntnose Sixgill Shark

Potential predators of the Bluntnose Sixgill Shark may include Steller sea lion (*Eumetopias jubatus),* Elephant Seal (*Mirounga angustirostris*), Killer whale (*Orcinus orca*), White Shark (*Carcharadon carcharias)* (COSEWIC 2007a), and possibly other shark species (Ebert, pers. comm., 2011). Bluntnose Sixgill Sharks have been observed to readily attack each other if one becomes distressed (Bigelow and Schroeder 1948; Ebert pers. comm. 2011).

The Bluntnose Sixgill Shark is an opportunistic predator primarily foraging nocturnally on a wide variety of prey items including cephalopods, crustaceans, several species of bony fish (e.g., Pacific hake (*Merluccius productus*), herring (*Clupea harengus*), flounders (*Pleuronectidae*), cod (*Gadidae*), mackerels (*Scombridae, Carangidae*), and rockfish (*Scoraenidae*), sharks and rays (*Elasmobranchii*) and on the carcasses of marine mammals including porpoises (*Phocoenidae*), dolphins (*Delphinidae*), and sea lions (*Otariidae*) (Compagno 1984; Ebert 1986; Ebert 1994; Ebert 2003). A study on the west coast of Vancouver Island examined stomach contents of 56

juvenile Bluntnose Sixgill Shark; of these, 48 were empty, seven contained salmon (*Oncorhynchus sp*), and one contained squid (Order *Teuthida*) (Benson *et al.* 2001).

1.4.4. Ecological role of the Tope Shark

Little is known about predators of the Tope Shark. The few studies available indicate they are predated upon by other elasmobranches, including the White Shark (*Carcharodon carcharias*) and the Broadnose Sevengill Shark (*Notorynchus cepedianus*), and possibly marine mammals (Ebert 2003). In New Zealand, the Killer whale (*Orcinus orca*) has been reported to take Tope Shark off of commercial longlines (Visser 2000).

Worldwide, the diet of the Tope Shark consists mainly of bony fish and cephalopods (*Teuthoidea*) (Walker 1989). The Tope Shark is an opportunistic predator feeding upon several fish species in both pelagic and demersal environments (Ebert 2003). Juveniles prey less on fish and cephalopods, their diet consisting predominantly of small invertebrates (Walker 1989). Ripley (1946) provides the only documentation of Tope Shark diet in the northeast Pacific. Stomach contents found in his study include fish from a variety of families including herrings (*Clupeidae*), flatfish, plainfin midshipman (*Porichthys notatus*), rockfishes, mackerel, and perches (*Embiotocidae*), as well as cephalopods (Ripley 1946) (Ripley 1946). A recent study in the northeast Atlantic found the diet of adult Tope Shark to exist almost entirely of bony fish (98.8% by weight) (Morato *et al.* 2003). In Australia, bony fish comprised 47% of the diet by weight followed by cephalopods (37%) (Walker 1999). Diet likely varies considerably by season, location, and size of the shark.

1.4.5. Limiting factors for the Bluntnose Sixgill Shark and Tope Shark

Limiting factors are intrinsic to the biology and ecology of the Bluntnose Sixgill Shark and Tope Shark and, as such, cannot be mitigated or managed. These natural bottom-up, top-down processes are generally mediated by factors such as the availability and quality of prey and by predators, respectively. However, human activities may contribute pressures which alter the balance of these limiting factors, threaten the populations, or influence their conservation potential. In such cases, actions are necessary to ensure that human activities do not place undue stress on limiting factors. Limiting factors for these species are described in the subsequent paragraphs, and include life history features, climate and ocean conditions, and specialized habitat requirements.

Life history features such as longevity (estimated to be 80 years for Bluntnose Sixgill Shark and more than 45 years for Tope Shark), late age at maturity (estimated at 18-35 years for female Bluntnose Sixgill Shark and 13-17 years for female Tope Shark) and low fecundity (47-108 pups for Bluntnose Sixgill Sharks and 6-52 pups for Tope Sharks) characterize them as *equilibrium life history strategists* (King and McFarlane 2003). As such, they have a low intrinsic rate of increase (Smith *et al.*1998), and are unable to recover quickly after population reduction.

Climate and ocean conditions are known to impact the abundance and/or distribution and availability of plankton and fish species in the northeast Pacific Ocean (King 2005). The Bluntnose Sixgill Shark and the Tope Shark are opportunistic feeders and changes in prey

species are unlikely to limit population growth or stability. However, a long term downward shift in prey availability from natural or anthropogenic causes could influence the behaviour of these species and directly impact their feeding, migration and distribution patterns.

Bluntnose Sixgill Shark juveniles live in shallow nearshore areas, and adapt to live in deep water as adults. Large-scale natural or anthropogenic changes to these environments are likely to have detrimental effects on the species. For example, habitat degradation of nearshore nursery areas could be significant, as demographic models suggest that survival of juvenile sharks nearing maturity is proportionately more important to population maintenance than other age classes (Kinney and Simpfendorfer 2009). This represents one limiting factor that could be mitigated or managed.

1.5. Threats

The Bluntnose Sixgill Shark and the Tope Shark are threatened by various anthropogenic sources. Five classes of current threats have been identified in this Management Plan, which are entanglement/bycatch, pollution, habitat loss or degradation, climate and oceanographic change, and harassment. Historic threats included directed fisheries and entanglement/bycatch. The influence of some or all of these current threats may affect normal behaviour, habitat use, or result in direct mortality. In the Northeast Pacific ocean, the Bluntnose Sixgill Shark is found from Alaska, U.S., down through Baja California, Mexico. The Tope Shark is found from northern British Columbia, to Baja California including the Gulf of California, Mexico. However, the extent of individual migration throughout the distribution range is currently unknown. These are highly mobile sharks, so there is a possibility of transboundary exchange. The cumulative effect of any combination of these threats listed below in the threat classification table (Table 1), in conjunction with species-specific limiting factors (see Section 1.6 'Limiting Factors'), may result in more serious consequences than those of any single threat acting upon the population in isolation.

1.5.1. Threat classification

Assessment of threats to both the Bluntnose Sixgill Shark and Tope Shark (Table 1) allows for the prioritization of recommended management and other actions to prevent these species from becoming threatened or endangered. The following threats have been identified for both species and ranked in terms of significance, with the greatest threat to the survival of the species appearing at the top of the table. Current and historic threats have been identified under separate headings. It is to be noted that only current threats were ranked. Historical threats are identified due to the impact on the population, but have not been included in the ranking system as they currently have no level of concern to the present population. Description of each current and historic threat is provided in the section following the table. Threats identified in this table are specific to Canadian Pacific waters only; however, it can be assumed that these threats are relevant in the U.S. and Mexico components of each species range. Threats outside of Canada, such as the recreational fishery for Tope in California, have not been included here. Definitions of the terms used for ranking are available in Appendix III.

Table 1. Threat Classification Table

CURRENT THREATS				
1 Entanglement/Bycatch		Threat Attributes		
Threat Category	Accidental mortality	Extent	Widespread	
			Local	*Range-wide*
General Threat	Fishing and Aquaculture activities	Occurrence		Current
		Frequency		Recurrent
Specific Threat	Entanglement in fishing gear and aquaculture pens, bycatch	Causal Certainty		High
		Severity		Medium
Stress	Reduced population size/viability, local extinctions, increased juvenile mortality	Level of Concern	Medium	
2 Pollution		Threat Attributes		
Threat Category	Pollution	Extent	Widespread	
			Local	*Range-wide*
General Threat	Petroleum spills, waste from ocean going vessels, biological contaminants, atmospheric deposition	Occurrence		Unknown
		Frequency		Unknown
Specific Threat	Toxins, anaerobic conditions	Causal Certainty		Low
		Severity		Low
Stress	Increased mortality on Bluntnose Sixgill Shark juveniles, loss of reproductive success, prey availability	Level of Concern	Low	
3 Climate and Oceanographic Change		Threat Attributes		
Threat Category	Climate and natural disasters	Extent	Widespread	
			Local	*Range-wide*
General Threat	Climate and oceanographic change	Occurrence		Unknown
		Frequency		Unknown
Specific Threat	Reduced habitat and prey availability	Causal Certainty		Low
		Severity		Low
Stress	Reduced productivity, increased mortality	Level of Concern	Low	
4 Habitat Loss or Degradation		Threat Attributes		
Threat Category	Habitat Loss or Degradation	Extent	Localized	
			Local	*Range-wide*

General Threat	Coastal and nearshore development, aquaculture infrastructure, dredging	Occurrence	Current	
		Frequency	Continuous	
Specific Threat	Alteration of habitat for juvenile Bluntnose Sixgill Shark, behavioural disruption, prey availability	Causal Certainty	Low	
		Severity	Low	
Stress	Increased mortality on Bluntnose Sixgill Shark juveniles, prey availability	Level of Concern	Low	
5	Harassment	Threat Attributes		
Threat Category	Disturbance or harm	Extent	Localized	
			Local	*Range-wide*
General Threat	Recreational scuba diving for observing Bluntnose Sixgill Sharks, baiting of Bluntnose Sixgill Shark to surface for viewing	Occurrence	Current	
		Frequency	Continuous	
Specific Threat	Behavioural disruption, damage or injury to individuals	Causal Certainty	Low	
		Severity	Low	
Stress	Behavioral changes, increased mortality	Level of Concern	Low	
HISTORICAL THREATS				
	Directed fishing	Threat Attributes		
Threat Category	Resource use	Extent	Widespread	
			Local	*Range-wide*
General Threat	Commercial and Recreational Fishing Activity	Occurrence		Historic
		Frequency		Continuous
Specific Threat	Harvesting	Causal Certainty		High
		Severity		High
Stress	Reduced population size, local extinctions	Level of Concern	N/A	
	Entanglement/Bycatch	Threat Attributes		
Threat Category	Accidental mortality	Extent	Widespread	
			Local	*Range-wide*
General Threat	Commercial and Recreational Fishing Activity	Occurrence		Historic
		Frequency		Continuous
Specific Threat	Entanglement, Bycatch	Causal Certainty		High
		Severity		Medium
Stress	Reduced population size	Level of Concern	N/A	

1.5.2. Description of threats

Current Threats

The only threat identified in the COSEWIC Assessment Reports (2007a, 2007b) to both the Bluntnose Sixgill Shark and the Tope Shark was fishing. This threat is here classified as 'entanglement/bycatch'. The Technical Team identified four additional current threats, which include pollution, climate and oceanographic change and harassment, habitat loss or degradation. While these populations are migratory throughout the northeast Pacific, it is unknown whether threats occurring outside of Canadian Pacific waters have an impact on these populations. For example, commercial landings of Tope Shark in California averaged approximately 150 tonnes annually from 1990-1999; however, no data exists for landings from recreational fisheries (Ebert 2001). It is unknown whether this level of removal has any impact on the Tope population within Canadian Pacific waters. All five current threats to the Bluntnose Sixgill Shark and Tope Shark within Canadian Pacific waters are discussed in further detail below.

Entanglement/Bycatch

Fishing activities are the primary threats to the Bluntnose Sixgill Shark and the Tope Shark. Currently, the only directed shark fishery in Canadian Pacific waters is for Pacific Dogfish (*Squalus acanthias*). Both the Bluntnose Sixgill Shark and the Tope Shark are incidentally caught in other fisheries, particularly the groundfish trawl and groundfish hook and line fisheries (Tables 2-5). Commencing with the 2011/2012 season, no commercial fishery in Canadian Pacific waters is permitted to retain Bluntnose Sixgill or Tope Shark; all bycatch for these species is to be released at sea with the least possible harm. The level of bycatch and entanglement of Bluntnose Sixgill Shark and Tope Shark in Aboriginal fisheries and aquaculture is unknown.

Commercial Groundfish Trawl Fisheries

The commercial groundfish trawl fleet has been monitored with 100% at-sea observer[1] coverage since 1996. Prior to 2001, reporting of non-commercial elasmobranch species was incomplete in this fishery (COSEWIC 2007a). Between 2001 and 2009, a total of 6.2 t of Bluntnose Sixgill Shark was reported as bycatch, which equates to approximately 0.7 t/yr. The number of Bluntnose Sixgill Shark this represents is unknown; however, if we assume an average size of 40 kg, as observed in trawl bycatch since 2001 (PacHarvTrawl and GFFOS databases), then 19 Bluntnose Sixgill Shark per year are possibly being caught by trawl gear (Table 2). Since 2001, approximately 63% of the total catch has occurred within Pacific Marine Fisheries Commission (PMFC) areas 3C/D (west coast of Vancouver Island) and 4B (Strait of Georgia). See Appendix IV for a map of PMFC areas.

[1] As a condition of licence, all commercial groundfish vessels must have 100% at-sea monitoring. For hook and line and trap vessels, this may include either electronic monitoring or a third-party at-sea observer. For Option A trawl vessels (fishing outside of the Strait of Georgia), this includes a third-party at-sea observer; for Option B (fishing in the Strait of Georgia) and mid-water directed Pacific hake trawl vessels, this includes electronic monitoring.

Table 2. Commercial trawl catch (kg) and number of Bluntnose Sixgill Shark in British Columbia waters from 1996 to 2009 by PMFC management areas (3C= southwest Vancouver Island; 3D= northwest Vancouver Island; 4B= Strait of Georgia; 5A= Queen Charlotte Sound south; 5B= Queen Charlotte Sound north; 5C=southern Hecate Strait; 5D= northern Hecate Strait; 5E= west coast of Haida Gwaii). Updated and revised from COSEWIC 2007a.

Year	Area and Catch (kg)									Total (kg)	Total (Est. # sharks)
	3C	3D	4B	5A	5B	5C	5D	5E	UNK		
1996	0	82	0	252	23	0	0	0	0	356	9
1997	54	31	0	82	130	0	0	0	0	297	7
1998	1867	16	14*	14	0	0	0	0	0	1910	48
1999	2	0	0	194	446	0	0	2268	0	2909	73
2000	308	84	91*	0	91	0	0	581	0	1154	29
2001	14	0	305	68	0	0	0	0	0	386	10
2002	819	384	136	0	204	544	0	0	0	2087	52
2003	95	576	261	27	318	0	0	0	0	1277	32
2004	40	68	0	0	68	91	0	0	0	267	7
2005	0	100	60	23	0	14	0	45	0	241	6
2006	57	36	58*	0	159	45	21	0	0	376	9
2007	397	0	232*	0	7	0	0	0	252†	888	22
2008	22	0	288*	0	0	0	0	227	251‡	788	20
2009	143	118	164*	0	116	0	0	0	53‡	594	15
Total (kg) (1996-2009)	**3817**	**1495**	**1608**	**659**	**1561**	**694**	**21**	**3121**	**556**	**13532**	**338**
Average (kg) (2001-2009)	**176**	**142**	**167**	**13**	**97**	**77**	**2**	**30**	**62**	**767**	**19**

* from fisherman logbook
† from a dockside observer validation
‡ from both fisherman logbooks and dockside observer validations
Source: PacHarvTrawl and GFFOS fisheries databases.
All data are from observer logbooks, unless otherwise noted. Data prior to 2001 is considered incomplete and not included in average. Number of sharks is estimated by assuming an average weight of 40 kg.

Between 2001 and 2009, a total of 4.4 t of Tope Shark has been incidentally caught by British Columbia trawl fisheries, which equates to approximately 0.48 t/yr. Assuming an average weight of 21 kg, as observed in trawl bycatch since 2001 (COSEWIC 2007b), it is estimated that 23 Tope Shark per year are caught by the trawl fleet. Most of the catch is from PMFC areas 3C/D (Table 3).

Table 3. Commercial trawl catch (kg) and number of Tope Shark in British Columbia waters from 1997 to 2009 by PMFC management areas (3C= southwest Vancouver Island; 3D= northwest Vancouver Island; 4B= Strait of Georgia; 5A= Queen Charlotte Sound south; 5B= Queen Charlotte Sound north; 5C=southern Hecate Strait; 5D= northern Hecate Strait; 5E= west coast of Haida Gwaii). Updated and revised from COSEWIC 2007b.

Year	Area and Catch (kg)						Total (kg)	Total (Est. # sharks)
	3C	3D	5A	5B	5C	5D		
1997	27	0	0	0	0	0	27	1
1998	0	24	45	0	0	0	69	3
1999	0	0	0	0	18	0	18	1
2000	94	0	36	0	18	0	148	7
2001	83	45	58	68	29	83	366	17
2002	190	54	100	45	36	27	454	22
2003	75	98	163	101	54	0	491	23
2004	240	14	154	0	32	0	440	21
2005	762	401	78	191	73	0	1505	72
2006	302	107	23	0	34	0	465	22
2007	112	0	21	11	0	0	144	7
2008	68	23	0	0	57	39	187	9
2009	92	0	32	138	36	0	299	14
Total (kg) (1997-2009)	**2046**	**765**	**711**	**554**	**388**	**149**	**4613**	**220**
Average (kg) (2001-2009)	**214**	**82**	**70**	**62**	**39**	**17**	**483**	**23**

Source: PacHarvTrawl and GFFOS fisheries databases.
Data prior to 2001 is considered incomplete and not included in average. Estimated number of sharks based on mean weight of 21 kg.

Commercial Groundfish Hook and Line Fisheries

Hook and line groundfish fisheries, including fisheries for Pacific Dogfish, Lingcod, Rockfish, Halibut and Sablefish, have only recently (since 1999) been subject to at-sea observers. Since 2006 all vessels have been required to have 100% at-sea observer coverage either in the form of electronic monitoring or an at-sea observer. From 2001 to 2005, coverage was between 10-15% per fleet (DFO 2003, 2004, 2005). In addition, some fishers reported Bluntnose Sixgill Shark and Tope Shark catches in logbooks (Tables 4,5). Fishers are obligated to report catches of shark in their logbooks; however, sufficient monitoring could not verify accuracy and thus, the actual amount caught is estimated to be higher. Therefore, we expanded the estimates presented for 2001 to 2005 to 100% assuming 10% observer coverage during those years (Tables 4, 5). Using this expanded estimate, an average of 21.5 t of Bluntnose Sixgill Shark was caught annually (Table 4). Using an estimate of 60 kg average weight, as observed in the hook and line fisheries since 2001 (PacHarvHL and GFFOS databases), 359 Bluntnose Sixgill Shark could be captured annually by hook and line fisheries.

Table 4. Commercial Hook and Line catch (kg) of Bluntnose Sixgill Shark in British Columbia waters from 2001 to 2009 by PMFC management areas (3C= southwest Vancouver Island; 3D= northwest Vancouver Island; 4B= Strait of Georgia; 5A= Queen Charlotte Sound south; 5B= Queen Charlotte Sound north; 5C=southern Hecate Strait; 5D= northern Hecate Strait; 5E= west coast of Haida Gwaii). Updated and revised from COSEWIC 2007a.

Year	Area and Catch (kg)									Total (kg)	Total (Est. # sharks)
	3C	3D	4B	5A	5B	5C	5D	5E	UNK		
2001	18	0	363	0	0	0	0	295	0	676 (6759)	11 (113)
2002	0	2573	37	562	141	0	95	0	0	3408 (34084)	57 (568)
2003	262	295	1039	0	182	113	91	286	0	2267 (22670)	38 (378)
2004	45	816	141	0	0	0	0	0	181	1184 (11837)	20 (197)
2005	0	0	0	0	0	0	0	0	0	0 (0)	0 (0)
2006*	18840	3480	8040	1320	540	60	1020	1140	0	34440	574
2007	9600	8040	10380	600	1200	1320	60	480	0	31680	528
2008	4320	3420	11700	1620	1980	960	420	3960	0	28380	473
2009	840	4200	6660	480	3420	3540	360	4740	0	24240	404
Total (kg) (2001-2009)	**33926**	**22824**	**38359**	**4582**	**7462**	**5993**	**2046**	**10901**	**181**	**126275 (194090)**	**2105 (3235)**
Average (kg) (2001-2009)	**3770**	**2536**	**4262**	**509**	**829**	**666**	**227**	**1211**	**20**	**14031 (21566)**	**234 (359)**

Source: PacHarvHL and GFFOS fisheries databases.

* starting April 2006, all hook and line vessels subject to 100% at-sea observer coverage in the form of electronic monitoring or at-sea observers.

From 2001-2005, estimated number of sharks based on a mean weight of **60 kg**. Total catch weight and number of sharks in parentheses represent extended values, from 10% to 100% observer coverage. From 2006-2009, fisherman logbooks recorded counts (or number of sharks). A catch weight for each year was calculated by multiplying the number of sharks caught by an average weight of **60 kg**, except where specified. Source: PacHarvHL and GFFOS fisheries databases.

A total of 15.1 t of Tope Shark was captured by hook and line fleets (Table 5) between 2001 and 2009, which equates to 1.7 t annually, based on expanded observer and logbook records. Using an estimate of 27 kg average weight, as observed in the hook and line fishery since 2001 (PacHarvHL and GFFOS databases), 62 Tope Shark could be incidentally caught annually by hook and line fisheries.

Table 5. Commercial Hook and Line catch (kg) of Tope Shark in British Columbia waters from 2001 to 2009 by PMFC management areas (3C= southwest Vancouver Island; 3D= northwest Vancouver Island; 4B= Strait of Georgia; 5A= Queen Charlotte Sound south; 5B= Queen Charlotte Sound north; 5C=southern Hecate Strait; 5D= northern Hecate Strait; 5E= west coast of Haida Gwaii). Updated and revised from COSEWIC 2007b.

Year	Area and Catch (kg)							Total (kg)	Total (Est. # sharks)
	3C	3D	5A	5B	5C	5D	5E		
2001	0	0	0	107	144	0	0	250 (2504)	9 (93†)
2002	0	9	34	0	49	0	0	92 (921)	3 (34)
2003	54	54	0	286	305	0	102	802 (8018)	30 (297†)
2004	2	0	0	0	0	0	0	2 (21)	0 (0)
2005	35	8	0	0	0	0	0	43 (427)	2 (16)
2006*	972	0	0	0	270	189	27	1458	54
2007	162	432	54**	0	93***	0	0	741	27
2008	27	0	27	27	270	0	0	351	13
2009	513	27	0	135	0	0	0	675	25
Total (kg) (2001-2009)	**1766**	**530**	**115**	**554**	**1131**	**189**	**129**	**4414 (15116)**	**163 (558)**
Average (kg) (2001-2009)	**196**	**59**	**13**	**62**	**126**	**21**	**14**	**490 (1680)**	**18 (62)**

Source: PacHarvHL and GFFOS fisheries databases.
From 2001-2005, estimated number of sharks based on a mean weight of **27 kg**. Total catch weight and number of sharks in parentheses represent extended values, from 10% to 100% observer coverage. From 2006-2009, fisherman logbooks recorded counts (number of sharks). A catch weight for each year was calculated by multiplying the number of sharks caught by an average weight of **27 kg**, accept where specified.
* starting April 2006, all hook and line vessels subject to 100% at-sea electronic monitoring.
** estimated catch weight a combination of at-sea observer weight (n = 1) and estimated weight from fisherman logbook (n = 1)
*** catch weight from at-sea observer.
† values are very high and are likely indicative of species misidentification.

A combined total of 21.7 t of Bluntnose Sixgill Shark (approximately 377 sharks) and 2.2 t of Tope Shark (approximately 85 sharks) are incidentally caught in groundfish trawl and groundfish hook and line fisheries annually. Mortality associated with this bycatch has not been investigated; however, many sharks are reported as "released alive". According to one Pacific Dogfish harvester, Bluntnose Sixgill Shark captured on longlines are usually lively at the surface and swim away when released (COSEWIC 2007a). The impact of this catch on the population depends on the size of the population which at present time is unknown for these species. At current minimum estimates of biomass for the west coast of North America (a minimum of 7,900 individuals of Bluntnose Sixgill Shark and 1,500 t of Tope Shark), it is unlikely present mortality levels are having a significant impact on the populations. This threat is considered to be a "medium" level of concern.

Pollution

The threat of pollution to the Bluntnose Sixgill Shark and Tope Shark could originate from petroleum spills from oil tankers, drill rigs, or ocean-going vessels; waste from ocean-going vessels; or biological contaminants via sewage outflow or industry discharge. Spills are recurrent events along the BC coast, and the likelihood of accidental spills may increase with high

densities of traffic or increased shoreline development. The subsequent decrease in water quality in the pelagic zone from spills or introduction of biological pollutants could result in increased mortality of Tope Shark and newborn or juvenile Bluntnose Sixgill Shark both directly and indirectly through a decline in prey availability. Biological contaminants accumulate in marine food webs, and magnification of these contaminants increase with increasing position in the food web. Given that both these species are apex predators, bioaccumulation of contaminants (from sewage outflow or industry discharge) may also be a concern, particularly for juveniles if they retain these contaminants and accumulate throughout their lifespan. No contaminant studies have been done on Bluntnose Sixgill Shark or Tope Shark; however, levels of persistent contaminants in other apex predators have been associated with health effects such as reproductive impairment, skeletal deformities, and suppression of the immune system (DFO 2009, 2010). While measures to prevent and mitigate effects of spills or discharge of biological contaminants are currently in place, success of these measures is highly dependent on proximity to population centers with facilities and expertise for cleanup. For example, once an oil spill occurs, the effectiveness of clean up measures is low (Graham 2004). As the threat of pollution is of unknown severity and low causal certainty, it is considered to be a "low" level of concern.

Habitat Loss or Degradation

A species' survival is subject to the conditions in the zone it occupies at any particular life stage. As Tope sharks rarely occupy nearshore coastal waters such as bays and inlets in Canadian Pacific waters, this is likely not a threat for them. The main nursery area for Tope shark is the Southern California Bight, which is heavily industrialized (Ebert, pers. Comm. 2011.) However, these impacts are obviously beyond management efforts in Canadian waters The urbanization of coastal areas in British Columbia through the development of marinas, docks, ferry terminals, tanker ports, wind farms, log dumps, aquaculture sites and other similar installations may result in the physical exclusion of juvenile Bluntnose Sixgill Shark from their preferred shallower water habitats. In addition, these activities and related ancillary works could create localized water quality issues which may compromise prey availability. Thus, physical degradation of habitat may displace juvenile Bluntnose Sixgill Shark, affect their potential to feed, or affect reproductive success. Due to high uncertainty with respect to frequency and severity, the level of concern is considered to be "low".

Climate and Oceanographic Change

Large scale climate change (decadal regime shifts, global warming) has been correlated with major step-like changes in zooplankton composition (Mackas *et al.* 2004) and fish (McFarlane *et al.* 2000, Beamish *et al.* 2008). Bluntnose Sixgill Shark and Tope Shark are known to feed on a variety of invertebrates and bony fishes which would be impacted by climate change. Impacts of climate change on these sharks may be limited to changes in food resources (e.g., abundance and distribution) and temperature, which would manifest themselves through changes in Bluntnose Sixgill Shark and Tope Shark distribution and growth. Little information is available on changes in shark distribution or other biological parameters in relation to prior decadal scale climate events. However, due to changing ocean productivity associated with climate change, it is likely these sharks, particularly Tope Shark and juvenile Bluntnose Sixgill Shark, would significantly change their distribution patterns following food resources. Also, given the affinity of females

for specific water temperatures, and newborn pups and juveniles for shallow water rearing (COSEWIC 2007a, Andrews *et al.* 2007), a warming climate may induce a major shift in spawning or parturition areas and nursery grounds (King *et al.* 2011). Due to the high uncertainty with respect to the occurrence, frequency and severity of the threat of climate change, the level of concern is considered to be "low".

Harassment

During the last few decades, a recreational SCUBA dive industry has developed in the Strait of Georgia and off the west coast of Vancouver Island, taking clients to dive with the Bluntnose Sixgill Shark. It is unknown whether these human-shark encounters impact normal behavior (i.e., feeding or nearshore residency times) of the Bluntnose Sixgill Shark, predominantly to the large juveniles. More recently, anecdotal reports have noted intentional feeding or baiting of Bluntnose Sixgill Shark to bring them to the surface for viewing, which could make them more susceptible to human impacts such as encounters with boats and fishing gears; however, it is to be noted that this is not a known practice in the dive industry. Further, the impacts of underwater noise through seismic, explosives, or otherwise on sharks in general has not been well documented. Overall, harassment is considered to be a "low" level of concern.

Historical Threats

Directed fishing

The Bluntnose Sixgill Shark has been the focus of at least three known directed fisheries in Canadian Pacific waters. The first fishery occurred in the early 1920s with a focus on their skins used to make shark leathers. The success of this venture in terms of sharks caught and duration is unknown .The second fishery took place between 1937 and 1946 with a focus on the shark livers for vitamin A. Between 1942 and 1946, 276 t of Bluntnose Sixgill Shark liver (approximately 3800 sharks) was marketed in British Columbia (COSEWIC 2007a). Similar liver-directed fisheries for Bluntnose Sixgill Shark occurred in adjacent Washington State waters during this time period (Bargmann pers. comm. 2006). The combined long-term effect of these fisheries on the northeast Pacific population has never been investigated. The third commercial fishery for the Bluntnose Sixgill Shark within Canadian Pacific waters commenced under an experimental basis in the late 1980s and again in 1994, but was terminated due to conservation concerns, particularly since the experimental fishery captured only juveniles (McFarlane *et al.* 2002).

The Tope Shark was the target of a brief but extensive commercial fishery throughout their northeast Pacific range beginning in 1937 in California and then in British Columbia, Oregon, and Washington in the early 1940s. This fishery targeted the Tope Shark primarily to extract for their liver, which contains the highest concentrations of vitamin A of any fish on the Pacific coast. A total of approximately 840,000 Tope Shark may have been taken from the northeast Pacific population; of this total, 50,000 were estimated to have landed in Canadian ports, although the amount actually caught in Canadian waters is unknown. The Canadian fishery took place primarily off the west coast of Vancouver Island and in Hecate Strait (COSEWIC 2007b). Canadian fishing magazines were reporting a decrease in Canadian abundance starting in 1944, and by 1946 the Canadian fishery had substantially diminished. Vitamin A was first synthesized

in 1947, which removed the demand on natural sources for its procurement. By 1949, the Canadian fishery for Tope Shark had ended.

The intensive fishery for Tope Shark between 1937 and 1949 throughout their migratory range in the northeast Pacific caused depletion in the adult biomass (Walker 1999; Ebert 2003). Since that time, the Tope Shark has not received any commercial or research attention. The degree to which the stock has recovered since the 1940s is unknown. Walker (1999) argues that although the fishery collapsed during the 1940s, due to the manufacture of synthetic Vitamin A, it is unlikely the stock collapsed.

Entanglement

Little information exists on bycatch of Bluntnose Sixgill Shark and Tope Shark in the historic record as shark bycatch was not broken down by species. Although limited, the information that does exist indicates both species were caught in groundfish longline and to a lesser extent trawl fisheries. It is likely, given the lower effort levels in these fisheries compared to more recent fisheries, that bycatch levels would have been very low.

1.6. Actions Already Completed or Underway

Internationally, the IUCN Red List has assessed the Bluntnose Sixgill Shark as 'near threatened' globally (Cook and Compagno 2005), and Tope Shark as 'vulnerable' globally and as 'least concern' in the northeast Pacific region (Walker *et al.* 2006). Bluntnose Sixgill Sharks are included under Annex 1 of the UN Convention on the Law of the Sea. Under the Inter-American Tropical Tuna Commission, of which Canada is a party, all sharks incidentally caught within IATTC fisheries must be reported, and released unharmed and alive with minimal harm, where practicable; and any landings of shark must use the full shark carcass (IATTC 2005).

Within Canada, as with all marine species, the Bluntnose Sixgill Shark and Tope Shark are federally protected under the Fisheries Act. Commencing with the 2011/2012 season, no commercial fishery in Canadian Pacific waters is permitted to retain Bluntnose Sixgill Shark and Tope Shark; all fisheries are required to release these species bycatch at sea with the least possible harm. Since 1996, the groundfish bottom trawl fishery has been monitored intensively (100% observer coverage on all trips); since 2006, all commercial hook and line/trap groundfish fisheries have 100% at-sea monitored in the form of observers or electronic monitoring. This monitoring, in addition to fishing logbooks, should allow for more accurate accounting of shark bycatch in these fisheries. Recreational shark fishing is managed under the finfish recreational fisheries. While Bluntnose Sixgill Shark have been protected from retention in the recreational fishery since 1996, a recent Variation Order to the BC Sport Fishing Regulations provided further conservation measures for shark species within the recreational fishery. As of April 1, 2011, catch limits will be reduced from 20 individuals per day to "no fishing" for all SARA-listed species (including Bluntnose Sixgill Shark and Tope Shark), and "zero retention" (catch and release) for all other shark species with the exception of Salmon Shark, which was reduced to a daily limit of one individual per day and a possession limit of two, and Spiny Dogfish, which was reduced to a daily limit of four individuals per day and a possession limit of eight. These

measures are captured in the 2011-2013 BC Tidal Waters Sport Fishing Guide.

A "Sharks of British Columbia" Identification Guide was created in 2011 to increase proper identification and enhance awareness of shark species in Canadian Pacific waters. This guide was distributed to all groundfish commercial harvesters as part of their 2011/2012 licences, and is available for distribution to commercial and recreational harvesters as well as for communication and outreach purposes. Scientific research has been conducted for these species; however, numerous knowledge gaps exist (see section 1.7, "Knowledge Gaps"). A Bluntnose Sixgill Shark tagging survey was conducted in March 2011 to provide information on the seasonal distribution, movement, and migration in the Strait of Georgia. Eight Bluntnose Sixgill Sharks were tagged in this survey, results of which are anticipated to be available in Spring 2012. Further, information on genetic population stock structure does not currently exist for shark species that utilize Canadian Pacific waters. A genetic sampling program was implemented in spring 2011 to collect biological samples from scientific surveys as well as from incidentally caught species via the at-sea observer program. Additional funding past 2011 will be considered, as required.

1.7. Knowledge Gaps

Knowledge gaps for both the Bluntnose Sixgill Shark and the Tope Shark include information pertaining to the species' abundance, current abundance trends, distribution, biology, ecology and threats. For example, information on biological parameters such as longevity, age at first maturity, fecundity and survival rates is limited and is vital to understanding factors that regulate population productivity. Information on pupping or nursery grounds throughout its range would help identify the nearshore residency times by juveniles and timing of subsequent migration to deepwater habitat. Information on genetic makeup within B.C. will foster an understanding of local and regional dispersal and will allow identification of stock structure to assist in the management of population level threats. The current effects of pollutants on both species are unknown (particularly pollutants resulting from atmospheric fallout) and vital given their apex predator status. This would assist in understanding the impact of this threat to both species. Further, more detailed information on diet requirements for both species and the seasonal abundance and distribution of prey may be important in identifying areas where future fisheries interactions may occur, and /or the impacts of climate change. While Bluntnose Sixgill Shark and Tope Shark are often "released live" when incidentally caught, actual mortality of these released sharks is unknown. Further, the level of bycatch and entanglement of Bluntnose Sixgill Shark and Tope Shark in Aboriginal fisheries and aquaculture is unknown.

2. MANAGEMENT

Despite uncertainty regarding species' biology or conservation needs, management actions that may reduce the risk of population level effects of threats should be undertaken.

2.1. Goal

The management goal for the Bluntnose Sixgill Shark and Tope Shark is to maintain their abundance within Canadian Pacific waters at current or higher levels.

As a main purpose of SARA is to manage species of Special Concern so as to prevent them from becoming Threatened or Endangered, the goal of this management plan focuses on maintaining abundance at current or higher levels. Ensuring that the populations of these species can maintain or improve current levels of abundance is a key priority. There is high uncertainty regarding the numbers of Bluntnose Sixgill Shark and Tope Shark which utilize habitat in B.C.; however, current minimum estimates of biomass for the northeast Pacific include 7,900 individuals of Bluntnose Sixgill Shark (Larson *et al.* 2005) and 1,500 t of Tope Shark (COSEWIC 2007b). As knowledge gaps remain regarding stock structure for both species, it may be important to preserve any unique genetic or behavioural features of these populations. There is limited information on latitudinal movements of the Bluntnose Sixgill Shark; however, Tope Shark move between Canadian and U.S. waters (Herald and Ripley 1952; Walker 1989). Further, the extent of individual migration throughout the distribution range is currently limited, although a recent study in Puget Sound (Andrews *et al.* 2010) indicates both seasonal and latitudinal movements of some Bluntnose Sixgill Sharks in this area. The role of Canadian management will be to protect the population within Canada, and collaborate on potential research and conservation initiatives with the U.S. Contributions might extend to include research in Mexican waters, since extent of migration throughout the range is currently unknown. It will be necessary to address knowledge gaps regarding each species biology (see Section 1.7) and threats (see section 1.5) in order to achieve the stated goal.

2.2. Objectives

The following statements are objectives (not listed in order of priority) to be met by 2017 to support the management of the Bluntnose Sixgill Shark and Tope Shark within Canadian Pacific waters:

1. Improve scientific knowledge of abundance, biology, ecology, stock structure, and threats to these species.
2. Maintain viable populations and prevent a decline to levels at which they would become Threatened or Endangered.
3. Maintain the species' current range of occupancy and distribution.
4. Enhance communication and outreach of the biology, management, monitoring, research, and enforcement activities of these species.

There are significant knowledge gaps on the general biology and ecological role of the Bluntnose Sixgill Shark and Tope Shark, and addressing these knowledge gaps will aid in directing management efforts. Improving scientific knowledge with respect to species' biology and their threats will help to provide the framework on which to base future management actions. Maintenance of the abundance and distribution of Bluntnose Sixgill Shark and Tope Shark in Canadian Pacific waters over the next three generations will require that these populations be protected within Canada. Enhancing communication and awareness of both the species and conservation activities will assist in proper identification and general conservation of the species.

2.3. Actions

The following eleven actions (not listed in order of priority) are in support of management goals and objectives outlined in Sections 2.1 and 2.2. Many of the actions listed below are currently underway (see Section 1.6 'Actions already completed or underway'). The synchronization of these listed activities for management, research and monitoring and assessment will facilitate a multi-species approach to conservation of the Bluntnose Sixgill Shark and Tope Shark populations in Canadian Pacific waters, and allow for the effective use of available resources. Actions have been recommended where implementation is deemed to be practicable and feasible, and most likely to result in successful protection of the population in Canadian Pacific waters.

Where responsibility for actions is determined to fall under DFO or Parks Canada Agency jurisdiction, actions will be implemented directly as availability of funding and other resources permits. However, collaboration with other responsible agencies and organizations will be necessary in some cases to complete actions. If responsibility for actions falls outside of the mandate of DFO, Parks Canada Agency, or outside of their respective jurisdictions, support for implementation of the action(s) and contribution to effort(s) will be a priority where feasible. Participating agencies and organizations as well as implementation timelines for each of the listed actions are presented in Table 6.

2.3.1. Management

No directed fisheries exist within Canadian Pacific waters for Bluntnose Sixgill Shark or Tope Shark. However, both species are incidentally caught within other fisheries, identified as a threat of 'medium' concern, and explained in further detail in Section 1.5.2. Management and mitigation efforts for shark bycatch are captured in each fishery's licence conditions as well as in the Integrated Fisheries Management Plans (IFMPs). Fisheries and Oceans Canada uses IFMPs to guide the conservation and sustainable use of marine resources, combining the best available science on a species with industry data on capacity and methods for harvesting that species, which includes requirements for bycatch. The conditions of licence for each fishery further outline prohibited species and requirements for reporting bycatch. As a condition of licence, all commercial groundfish vessels must have 100% at-sea monitoring. For hook and line and trap vessels, this may include either electronic monitoring or a third-party at-sea observer. For Option A trawl vessels (fishing outside of the Strait of Georgia), this includes a third-party at-sea observer; for Option B (fishing in the Strait of Georgia) and mid-water directed Pacific hake trawl vessels, this includes electronic monitoring. Commencing with the 2011/2012 season, no

commercial fishery in Canadian Pacific waters is permitted to retain Bluntnose Sixgill Shark and Tope Shark; all fisheries are required to release Bluntnose Sixgill Shark or Tope Shark incidentally caught at sea with the least possible harm. Recreational shark fishing is managed under the finfish recreational fisheries. Through a recent Variation Order to the BC Sport Fishing Regulations, recreational catch limits of shark species were reduced from 20 individuals per day to "no fishing" for all SARA-listed species including Bluntnose Sixgill Shark and Tope Shark. The level of bycatch and entanglement of Bluntnose Sixgill Shark and Tope Shark in Aboriginal fisheries and aquaculture is unknown.

Management actions to address key threats are listed below.

1. Develop Codes of Conduct to reduce mortality by both aquaculture entanglement and bycatch of Bluntnose Sixgill Shark and Tope Shark in all commercial and recreational fisheries.
2. Continue the permitting of scientific research, monitoring and assessment, with reporting requirements, to address key knowledge gaps and clarify identified threats for Bluntnose Sixgill Shark and Tope Shark in Canadian Pacific waters.

2.3.2. Research

The following areas are those that have been identified as a priority for research actions to address key knowledge gaps surrounding species biology, habitat and stock structure of the Bluntnose Sixgill Shark and Tope Shark. Research efforts to address data deficiencies will assist management actions for these species and should also be considered in the context of supporting those topics listed below (See Section 1.7 'Knowledge Gaps'). Where feasible, DFO will lead the research efforts listed below.

3. Conduct scientific research on the biology, ecology, stock structure and threats to:
    a. Determine the range, areas of aggregation and seasonal occurrence,
    b. Analyze the genetic population structure,
    c. Analyze biological contaminants,
    d. Investigate habitat and diet requirements,
    e. Provide an estimate of life history characteristics, and
    f. Collect size, sex and age samples, where possible.
4. Develop an index of relative abundance.
5. Develop a set of protocols for biological sampling of bycatch of Bluntnose Sixgill Shark and Tope Shark.

2.3.3. Monitoring

Catch monitoring data is collected through the at-sea observation programs outlined above. Further to the 100% at-sea observation program for the commercial groundfish fishery, voluntary logbooks exist for the salmon and herring fisheries. The level of bycatch and entanglement of Bluntnose Sixgill Shark and Tope Shark in recreational and Aboriginal fisheries and aquaculture is unknown.

6. Continue to collect bycatch information from groundfish fisheries of Bluntnose Sixgill Shark and Tope Shark in Canadian Pacific waters; improve bycatch information in all other fisheries.
7. Improve accuracy of species identification in reporting of bycatch information from all fisheries.
8. Encourage the reporting of entanglement in aquaculture gear and sightings by SCUBA divers.

2.3.4. Outreach and communication

To meet the management goal and objectives outlined in sections 2.1 and 2.2, it is imperative that Fisheries and Oceans Canada foster improved communication networks to increase awareness of Bluntnose Sixgill Shark and Tope Shark conservation initiatives. This includes enhancing public awareness of these species and encouraging responsible fishing practices and accurate reporting in all fisheries. This would include increased communications with other government agencies, First Nations, relevant fishery advisory boards (commercial, recreational, aquaculture, and aboriginal), at-sea observers, environmental non-government organizations (ENGOs), and international partners. Outreach initiatives intended to enhance First Nation, public and stakeholder awareness of these species are currently underway, such as presentations at community events as well as a "Sharks of British Columbia" identification guide intended to increase proper identification and enhance awareness of shark species in Canadian Pacific waters.

9. Enhance First Nation, public, and stakeholder awareness of these species.
10. Build intra- and interagency networks, where appropriate, for effective communication regarding strandings, aquaculture entanglement, and bycatch.
11. Collaborate with academic community, industry, environmental non-governmental organizations (ENGOs), and other government agencies on regional, national, and international efforts of research, monitoring, management and enforcement activities for the Bluntnose Sixgill Shark and Tope Shark.

3. PROPOSED IMPLEMENTATION SCHEDULE

Fisheries and Oceans Canada encourages other agencies and organizations to participate in the conservation of the Bluntnose Sixgill Shark and Tope Shark through the implementation of this management plan. Table 6 summarizes those actions that are recommended to support the management goals and objectives. The activities implemented by Fisheries and Oceans Canada will be subject to the availability of funding and other required resources. Where appropriate, partnerships with specific organizations and sectors will provide the necessary expertise and capacity to carry out the listed action. However, this identification is intended to be advice to other agencies, and carrying out these actions will be subject to each agency's priorities and budgetary constraints.

Table 6. Implementation Schedule

Action	Obj.	Priority	Threats or concerns addressed	Participating Agencies	Timeline
Management					
1. Develop Codes of Conduct to reduce mortality by both aquaculture entanglement and bycatch of Bluntnose Sixgill Shark and Tope Shark in all commercial and recreational fisheries.	2, 4	High	Entanglement / Bycatch	DFO, Harvesters, Stakeholders	2013
2. Continue the permitting of scientific research, monitoring and assessment, with reporting requirements, to address key knowledge gaps and clarify identified threats for Bluntnose Sixgill Shark and Tope Shark in Canadian Pacific waters.	1	High	Climate and Oceanographic Change, Habitat Loss or Degradation, Pollution	DFO	Ongoing
Research					
3. Conduct scientific research on the biology, ecology, stock structure and threats to a) determine the range, areas of aggregation and seasonal occurrence; b) analyze the genetic population structure; c) analyze biological contaminants; d) investigate habitat and diet requirements; e) provide an estimate of life history characteristics; and f) collect size, sex, and age samples, where possible.	1, 2, 3	High	Climate and Oceanographic Change, Habitat Loss or Degradation, Pollution	DFO, NOAA, harvesters, academic community, ENGOs	Ongoing
4. Develop an index of relative abundance.	1, 2	High	Entanglement / Bycatch, Climate and Oceanographic Change, Habitat Loss or Degradation, Pollution	DFO	2017
5. Develop a set of protocols for biological sampling of bycatch of Bluntnose Sixgill Shark and Tope Shark.	1	Medium	Entanglement / Bycatch	DFO, harvesters	2013
Monitoring					
6. Continue to collect bycatch information from groundfish fisheries of Bluntnose Sixgill Shark and Tope Shark in Canadian Pacific waters; improve bycatch information in all other fisheries.	1, 3	High	Entanglement / Bycatch, Habitat Loss or Degradation, Climate and Oceanographic Change	DFO, Harvesters	Ongoing

	Action	Obj.	Priority	Threats or concerns addressed	Participating Agencies	Timeline
7.	Improve accuracy of species identification in reporting of bycatch information from all fisheries.	1, 3	Medium	Entanglement / Bycatch, Habitat Loss or Degradation, Climate and Oceanographic Change	DFO, Harvesters	Ongoing
8.	Encourage the reporting of entanglement in aquaculture gear and sightings by SCUBA divers.	1, 3	Low	Entanglement / Bycatch	DFO, Harvesters (Aquaculture)	2014
Outreach and Communication						
9.	Enhance First Nation, public, and stakeholder awareness of these species.	4	High	Entanglement / Bycatch, Habitat Loss or Degradation, Harassment	DFO, Parks Canada Agency, First Nations, IUCN, Stakeholders	Ongoing
10.	Build intra- and interagency networks, where appropriate, for effective communication regarding strandings, aquaculture entanglement, and bycatch.	4	Medium	Entanglement / Bycatch	DFO, Parks Canada Agency, Harvesters	Ongoing
11.	Collaborate with academic community, industry, environmental non-governmental organizations (ENGOs), and other government agencies on regional, national, and international efforts of research, monitoring, management and enforcement activities for the Bluntnose Sixgill Shark and Tope Shark.	1, 2, 3, 4	High	Entanglement / Bycatch, Habitat Loss or Degradation, Climate and Oceanographic Change, Pollution, Harassment	DFO, Parks Canada Agency, NOAA, Harvesters, academic community, ENGOs	Ongoing

4. ASSOCIATED PLANS

The following recovery plan outlines several proposed actions and research priorities which may assist in addressing some of the knowledge gaps and threats to the Bluntnose Sixgill Shark and Tope Shark in Canadian Pacific waters.

- Recovery Strategy for the Basking Shark (*Cetorhinus maximus*) in Canadian Pacific waters [Final].

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5. CONTACTS

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APPENDIX I: BLUNTNOSE SIXGILL SHARK AND TOPE SHARK MANAGEMENT PLAN TECHNICAL WORKSHOP PARTICIPANTS

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APPENDIX II: RECORD OF COOPERATION AND CONSULTATION

The Bluntnose Sixgill Shark (*Hexanchus griseus*) and Tope Shark (*Galeorhinus galeus*) are listed as species of special concern on Schedule 1 of the *Species at Risk Act* (SARA). The Minister of Fisheries and Oceans (DFO) and the Minister of Environment, responsible for the Parks Canada Agency, are the competent minister for the Bluntnose Sixgill Shark and Tope Shark in Canadian waters. Both species migrate throughout the coast of the Province of British Columbia and within waters administered by the Parks Canada Agency. DFO established a small internal working group of technical experts to develop the initial draft of this recovery strategy. See section 6 of this document for a list of technical team members.

Letters were sent out to all coastal First Nations soliciting participation in the development of this Management Plan. Given that both populations considered in this document migrate through Canadian and U.S. waters, bilateral government and non-government input and collaboration was sought. The draft management plan was sent to Parks Canada Agency, Environment Canada, and the Province of British Columbia for review and comment.

In January 2011, a technical workshop was held to seek comments and inputs on the draft management plan, and ensure the document incorporated the best technical and scientific expertise on these species. Participants, listed in Appendix I, included scientific and technical experts from DFO, Parks Canada Agency, academia, the fishing industry, and environmental non-governmental organizations (ENGOs). Participants assisted in the prioritization of the threats, current research, knowledge gaps, management goals, objectives, actions and implementation schedule.

The draft management plan was posted to the DFO Pacific Region Consultation website (http://www.pac.dfo-mpo.gc.ca/saraconsultations) for a public comment period from May 10 to June 13, 2011. This consultation was primarily web-based, and included mail-outs of hard copy letters, emails, and faxes to all coastal First Nations soliciting input and feedback on the draft Management Plan. No comments on the document were received by First Nations. An initial draft of the management plan, along with a discussion guide and feedback form, was made available on the internet. Notification of this consultation period was also sent by electronic mail to a distribution list of stakeholders and ENGOs; technical workshop participants; government agencies; as well as several Departmental advisory committees including the Groundfish Integrated Advisory Board (GIAB), Halibut Advisory Board (HAB), Sablefish Advisory Committee (SAC), Groundfish Trawl Advisory Committee (GTAC), and the Groundfish Hook & Line Advisory Committee (GHLAC). Four feedback forms were received, including comments from the academic and recreational diving companies. Where appropriate, all feedback received during this consultation period has been incorporated into the final management plan.

APPENDIX III: THREAT ATTRIBUTES TERMINOLOGY

Table 7. Details on terms used for assessment of threats to the Pacific population of Basking Shark. Terms were obtained from Environment Canada's "Guidelines for Identifying and Mitigating Threats to Species at Risk" (Environment Canada, 2008).

Attribute	Level of Effect	Description
Extent	Widespread	Across the species range.
	Localized	
	Unknown	
Occurrence	Historical	Contributed to decline but no longer affecting the species.
	Current	Affecting the species now.
	Imminent	Is expected to affect the species very soon.
	Anticipated	May affect the species in the future.
	Unknown	
Frequency	One-time	
	Seasonal	Due to migration or particular seasons.
	Continuous	Ongoing.
	Recurrent	Reoccurs from time to time, but not on annual/seasonal basis.
	Unknown	
Severity	High	Very large population-level effect.
	Medium	
	Low	
	Unknown	
Causal Certainty	High	Evidence causally links the threat to stresses on population viability.
	Medium	Correlation between the threat and population viability, expert opinion, etc.
	Low	Assumed or plausible threat only.
Level of Concern	High	Overall level of concern for recovery of the species, taking into account all of the above factors.
	Medium	
	Low	

APPENDIX IV: PACIFIC MARINE FISHERIES COMMISSION (PMFC) AREAS

Figure 7. PMFC Groundfish Management Areas.