Australian Government
Department of the Environment

2010 NOMINATION – *Isurus paucus*

Section 1 - Legal Status, Distribution, Biological, Ecological

Conservation Theme

The conservation themes for the assessment period commencing 1 October 2009 (for which nominations close 26 March 2009) are **'terrestrial, estuarine and near–shore environments of Australia's coast', and 'rivers, wetlands and groundwater dependent species and ecosystems of inland Australia'**. *How does this nomination relate to the **conservation theme**?*	Longfin makos can be found along the coast of northern Australian and south to Geraldton in Western Australia and Port Stephens in New South Wales (Last & Steven 2009). Although a pelagic species, it is believed that female longfin makos approach shallower habitats near land to pup (Compagno 2001). The nomination for this species therefore relates to the nomination theme of 'near-shore environments of Australia's coast'.

Taxonomy

***2**. What are the **currently accepted scientific and common name/s** for the species (please include Indigenous names, where known)?* *Note any other scientific names that have been used recently. Note the species authority and the Order and Family to which the species belongs (Family name alone is sufficient for plants, however, both Order and Family name are required for insects).*	Scientific name: *Isurus paucus* Common names: * Longfin mako * Mako shark
***3.** Is this **species conventionally accepted**? If not, explain why. Is there any controversy about the taxonomy?*	This species is conventionally accepted.
4.** If **the species** is **NOT conventionally accepted**, please provide:* *(i) a taxonomic description of the species in a form suitable for publication in conventional scientific literature; **OR *(ii) evidence that a scientific institution has a specimen of the species and a written statement signed by a person who has relevant taxonomic expertise (has worked, or is a published author, on the class of species nominated)**,** that the person thinks the species is a new species.*	Not applicable.
5. *Is this species **taxonomically distinct** (Taxonomic distinctiveness – a measure of how unique a species is relative to other species)?*	Longfin makos are similar in appearance to shortfin makos (*Isurus oxyrinchus*), however the 2 species can be distinguished on the basis of morphological characteristics. Primarily, the pectoral fins of longfin mako are as long as the head length, and the underside of the snout and jaws are dusky in adults. In contrast, shortfin mako have pectoral fins that are considerably shorter than the head length, and the underside of the snout and jaws are white in adults (Last & Stevens 2009).

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Legal Status

5. *What is the species' **current conservation status** under Australian and State/Territory Government legislation?*	Longfin mako is not listed under any Australian or State/Territory Government legislation. In NSW, it is considered as *Undefined* because of the lack of observation programs that would allow an estimate to be derived from the composition of harvested sharks (Scandol et al. 2008).
6. *Does the species **have specific protection** (e.g. listed on an annex or appendix) under other legislation or intergovernmental arrangements, e.g. Convention on International Trade in Endangered Fauna and Flora (CITES), Convention on Migratory Species (CMS).*	Longfin mako was recently added to Appendix II of the Convention on Migratory Species in December 2008. Negotiations are currently underway for the development of a conservation agreement for migratory sharks under the auspices of the CMS, and the inclusion of longfin mako under this agreement is being discussed. Negotiations on this agreement are progressing intersessionally with the CMS aiming for the finalisation of this instrument by the end of 2009. Longfin mako is listed on Annex I, Highly Migratory Species, of UNCLOS, however, no catch limits for the species have been adopted by any Regional Fisheries Management Organisations that regulate high seas fisheries. This species is also listed as highly migratory under the UN Agreement on the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (UNFSA), which requires States to cooperate and adopt measures to protect the listed species (Reardon et al. 2006). In addition, longfin mako has been identified by the CITES Animals Committee as a species that may require consideration for inclusion in the CITES Appendices if their management and conservation status does not improve. Indirectly, this species is protected under the FAO International Plan of Action for the Conservation and Management of Sharks (IPOA–Sharks) for being a pelagic shark that's been exploited by more than one State on high seas. This plan of action recommends shark population assessments and regional shark management plans to be developed by the Regional Fisheries Organisations (Reardon et al. 2006). Longfin mako is listed as Vulnerable on the IUCN Red List of Threatened Species and its population trend is decreasing (Reardon et al. 2006).

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Description

7. *Give a brief description of the species' **appearance**, including size and/or weight, and sex and age variation if appropriate; social structure and dispersion (e.g. solitary/clumped/flocks).*	Appearance: Mako sharks are endothermic with body temperatures between 5 and 11ºC above ambient water temperature (Last & Stevens 2009). Longfin mako has a slender and elongated body with a pointed, long and conical snout. The eyes are relative large. The tail is crescent-shaped with upper and lower tail lobes similar in length. Its teeth are bladelike, long, pointed and without serrations or cusplets, and they protrude visibly from the mouth (visible with the mouth closed). There is no secondary keel on the caudal peduncle. The length of the pectoral fins is greater than the distance between the base of the fin and the snout tip. Females are larger than males, reaching a maximum size of 394 cm total length whereas males reach their maximum size at 280 cm total length. Its dorsal coloration is dark-blue or grey-black and its ventral coloration is white. The underside of the snout and jaws are dark (Compagno 1984, 2001; Macbeth et al. 2008; Passarelli et al. 2009). Social structure & Dispersion: Longfin mako is a pelagic species that occurs principally in the upper zones on the ocean. It is thought to be deep dwelling in offshore and oceanic waters (Macbeth et al. 2008). As they rely mostly on their vision to locate their prey, they penetrate greater depths during the daytime (Sepulveda et al. 2004). The size of pups at birth is approximately 97 to 120 cm (Compagno 2001). Relatively little is known about the social structure and biology of the longfin mako (Reardon et al. 2006).
8. *Give a brief description of the species' **ecological role** (for example, is it a 'keystone' or 'foundation' species, does it play a role in processes such as seed dispersal or pollination).*	The mako shark is an opportunistic apex predator (Compagno 1984). Its diet includes a wide variety of prey, mainly of teleost fishes and cephalopods (Last & Stevens 2009). This is a top predator, and therefore, plays an important role in structuring marine ecosystems (COSEWIC 2006). It helps to maintain to population sizes of prey species, as well as their genetic fitness by preying easily on weak and sick individuals (Last & Stevens 2009). The removal of a top predator may have effects on the entire ecosystem, however these effects are still largely unknown (Stevens et al. 2000).

Australian Distribution

9. *Describe the species' **current and past distribution in Australia** and, if available, attach a map.*	Longfin mako sharks are distributed in Australia's tropical and warm temperate seas. Although records are patchy, its distribution is though to extend from Australia's north, south to Geraldton in Western Australia, and Port Stephens in New South Wales (Last & Steven 2009). A map of their distribution in Australian waters is shown on the global distribution map given in Figure 1.
10. *What is the **extent of occurrence** (in km^2) for the species (described in Attachment A); explain how it was calculated and datasets used.*	
a. *What is the **current** extent of occurrence?*	The extent of occurrence of longfin mako has not been determined in terms of square kilometres. The Australian distribution of the species has been described as extending throughout northern Australia's waters, and south to Geraldton in Western Australia, and Port Stephens in New South Wales (Last & Stephens 2009).

b. *What data are there to indicate **past declines** in extent of occurrence (if available, include data that indicates the percentage decline over the past 10 years or 3 generations whichever is longer)?*	There are no data available to enable assertions to be made on past declines in extent of occurrence in Australian waters.
c. *What data are there to indicate **future changes** in extent of occurrence (if available, include data that indicates the percentage decline over 10 years or 3 generations whichever is longer (up to a maximum of 100 years in the future) where the time period is a continuous period that may include a component of the past)?*	There are no data available that specifically indicates future changes in extent of occurrence.
***11.** What is the **area of occupancy** (in km^2) for the species (described in Attachment A); explain how calculated and datasets that are used.*	
*a. What is the **current** area of occupancy?*	Longfin mako sharks are a pelagic and highly migratory species. As such, they move throughout the extent of occurrence described in Q10. Data do not exist on unoccupied habitats within the extent of occurrence. It is therefore difficult to determine the current area of occupancy for this species.
*b. What data are there to indicate **past declines** in area of occupancy (if available, include data that indicates the percentage decline over the past 10 years or 3 generations whichever is longer)?*	There are no readily available data that elucidates past declines in the area of occupancy for this species in Australian waters or anywhere in the world.
*c. What data are there to indicate **future changes** in area of occupancy (if available, include data that indicates the percentage decline over 10 years or 3 generations whichever is longer (up to a maximum of 100 years in the future) where the time period is a continuous period that may include a component of the past)?*	There are no readily available data that indicates future declines in the area of occupancy for this species in Australian waters or anywhere in the world.
***12.** How many **natural locations** do you consider the species occurs in and why? Where are these located?* *The term 'location' defines a geographically or ecologically distinct area.*	Longfin mako is a pelagic migratory species and as such is not found in discrete locations. They inhabit Australia's tropical and warm temperate waters along the northern coastline and seas, south to Geraldton in Western Australia and Port Stephens in New South Wales (Last & Stevens 2009).
***13**. Give **locations of other populations**: captive/propagated populations; populations recently re-introduced to the wild; and sites for proposed population re-introductions. Note if these sites have been identified in recovery plans.*	There is no evidence of either captive or propagated populations in the scientific literature. As such, there are not likely to be any populations that have been re-introduced into the wild, or any sites that are proposed for population re-introductions.
***14**. Is the species' **distribution severely fragmented?** What is the cause of this fragmentation? Describe any biological, geographic, human-induced or other barriers causing this species' populations to be fragmented.* *Severely fragmented refers to the situation in*	The lack of population data for the species makes is difficult to determine the degree of fragmentation of the species' distribution. There is a paucity of genetic research on longfin mako, however, it is thought that the Atlantic and Indo Pacific populations are possibly isolated as they are separated by cold waters off southern Africa and southern South America (Heist et al. 1996).

which increased extinction risk to the taxon results from most individuals being found in small and relatively isolated subpopulations (in certain circumstances this may be inferred from habitat information). These small subpopulations may go extinct, with a reduced probability of recolonisation.	
***15**. Departmental Use Only:*	

Global Distribution

***16.** Describe the species' **global distribution**.*	The complete global distribution of longfin mako is still unclear. However it is known for being cosmopolitan in tropical and warm temperate waters around the globe (Reardon et al. 2006). Mako sharks are commonly found from about 50ºN to 50ºS (Figure 1). This is an oceanic and pelagic species and its distribution is mostly determined by water temperature. As such it is almost never found below 16ºC (Fowler 2005). Compagno (2001) suggests that longfin mako shark is common in the western Atlantic and central Pacific, although it is thought to be much rarer than the closely related shortfin mako.
***17.** Give an overview of the **global population**'s size, trends, threats and security of the species outside Australia.*	Longfin mako sharks are considered a rare species, but are most common in western Atlantic and central Pacific. Mako sharks are highly vulnerable to overexploitation due to their low productivity (i.e. a low biological ability to sustain fishing or to recover from overfishing) and a high level of susceptibility (the level at which a species is likely to be affected by fishing) because of their overlapping distribution with pelagic fisheries targeting tuna and swordfish (Simpfendorfer et al. 2008). As such, they are commonly caught incidentally in these longline fisheries. However, the mortality rate due to by-catch is unknown and underestimated due to misidentification with the shortfin mako (which occurs principally on warmer waters where these two species overlap (COSEWIC 2006)), and because of the uncertainty of the number of individuals that are caught for their fins and discarded at sea (Reardon et al. 2006). Nevertheless, due to its similarity with the more common shortfin mako, it is likely that longfin mako have been experiencing similar declines due to high fishing pressures from commercial longline fleets, which has been estimated to be 50% or more for the shortfin mako (Reardon et al. 2006), and 40% in the northwest Atlantic for both mako species (Baum et al. 2003). A recent report on over-exploitation for data-poor pelagic Atlantic sharks suggested that along with the shortfin mako (*Isurus oxyrinchus*) and the bigeye thresher (*Alopias superciliosus*), longfin mako has the highest levels of risk of overexploitation of Atlantic pelagic sharks (Simpfendorfer et al. 2008). Longfin mako sharks are also at risk from the trade in shark fins. Although longfin makos are much less abundant in catches and trade than shortfin mako sharks, it has also been identified regularly in fin markets, sometimes in a species-specific market classification and sometimes classified with shortfin mako or thresher shark fins.
***18.** Explain the **relationship** between the Australian population and the global population, including:*	
a. *What **percentage** of the global population occurs **in Australia**;*	As there are no population estimates for longfin mako worldwide, it is difficult to determine the percentage of the global population that occurs in Australian waters.

b. *Is the Australian population **distinct**, geographically **separate** or does part or all of the population move in/out of Australia's jurisdiction (give an overview; details in Movements section);*	Tagging studies on longfin mako that elucidate the duration and extent of migrations to and from Australian waters are yet to be undertaken. However, it is considered likely that longfin mako sharks undertake similar long distance migrations in pelagic waters to shortfin makos. Tagging studies of shortfin makos in New Zealand have shown this species travels widely, at least between New Zealand, Australia and several South Pacific islands. At this stage it is unknown whether sharks in the southwest Pacific mix with those in other areas (NZ Ministry of Fisheries 2007).
c. *Do **global threats** affect the Australian population*?	Longfin mako sharks are highly migratory, and it is thought they migrate across high seas areas and between national jurisdictions. Therefore, the migratory nature of this species makes them extremely vulnerable to global threats such as by-catch in commercial fisheries.

Surveys and Monitoring

***19**. Has the species been **reasonably well surveyed**?* *Provide an overview of surveys to date and the likelihood of its current known distribution and/or population size being its actual distribution and/or population size.*	This species has not been well surveyed and as a result there is a great lack of information available on its population dynamics. As it is a rarer species than the shortfin mako, the majority of studies have been conducted on shortfin mako in the North Atlantic. As such, the status of populations of longfin mako is largely unknown, principally due to its rarity, and because of the difficulty involved in its capture, being a large shark and one of the fastest that exists (Campana et al. 2005).
***20**. For species nominated as extinct or extinct in the wild, please provide details of the **most recent** known **collection**, or authenticated **sighting** of the species and whether additional populations are likely to exist.*	Not Applicable.
***21**. Is there an ongoing **monitoring programme**? If so, please describe the extent and length of the programme.*	Currently, the Cooperative Shark Tagging Program (CSTP) is the most extensive shark-tagging program. This data will help analyse the status of numerous shark populations in the northwest Atlantic. However, it is unclear whether this monitoring program will provide information on longfin mako sharks. It is, however, providing information on shortfin mako, that will provide greater clarity on its population status, biology, trends, and conservation measures worldwide (Wood 2007). Due to the similarity between shortfin and longfin makos, this information may be useful to extrapolate to longfin mako populations. In Australia, Paul Rogers is conducting a PhD project on "Movement patterns and foraging dynamics of pelagic sharks in southern Australia: determining critical habitats, hotspots and migratory pathways". This study is funded by School of Biological Sciences at Flinders University, SARDI Aquatic Sciences, Nature Foundation SA Inc, Department for Environment and Heritage, and Wildlife Conservation Fund South Australia. The aim of the study is to learn more about the distribution and movement patterns of shortfin makos in southern and western Australia (however, this data might be used to understand better distribution and movement patterns of longfin makos as well). The project began in March 2008 in the Great Australian Bight. SIRTRACK satellite tags were installed on five shortfin mako sharks and one blue shark (SCIENG 2009). The report will be completed after a review process within the next few months ([redacted] [redacted] personal communication).

Life Cycle and Population

***22.** What is the species' total population*	There have been no population estimates completed for longfin mako

*size in terms of **number of mature individuals**? How were population estimates derived and are they reliable? Are there other useful measures of population size and what are they?* In the absence of figures, terms such as common, abundant, scarce can be of value.	shark anywhere in the world. Fisheries data have, however, provided estimates of decline in global populations (see Q17).
***23.** Does the species occur in a **number of smaller populations**? How many? For each population give the locality, numbers and trends in numbers and tenure of land (include extinct populations). Can these be considered to be subpopulations and why?* **Subpopulations** are defined as geographically or otherwise distinct groups in the population between which there is little demographic or genetic exchange.	Comprehensive genetic studies have not been conducted on longfin mako sharks, however preliminary observations indicate that the Atlantic and Indo Pacific populations are possibly isolated , being separated by cold waters off southern Africa and southern South America (Schrey & Heist 2003). Observations have not yet been made for elsewhere around the world.
***24.** Provide details on ages of the following:*	
***a.** sexual maturity;*	Mako sharks reach sexual maturity at 7-8 years for both sexes. Size is a better indicator of sexual maturity than age. Female longfin mako sharks mature at approximately 245 cm, while males reach maturity at 205 – 228 cm (Last & Stevens 2009)
***b.** life expectancy;*	The life expectancy for shortfin mako sharks is of 29-32 years (Dulvy et cl. 2008), however it is unknown for longfin makos.
***c.** natural mortality.*	Rate of natural mortality if shortfin mako is 0.16. This parameter has not been calculated for longfin mako.
25. **Reproduction**	
***For plants**: When does the species flower and set fruit? What conditions are needed for this? What is the pollinating mechanism? If the species is capable of vegetative reproduction, a description of how this occurs, the conditions needed and when. Does the species require a disturbance regime (e.g. fire, cleared ground) in order to reproduce?*	Not applicable
***For animals**: provide overview of breeding system and of breeding success, including: when does it breed; what conditions are needed for breeding; are there any breeding behaviours that may make it vulnerable to a threatening process?*	Longfin makos are ovoviviparous. The gestation period of 15-18 months begins in fall and ends with births occurring mainly in late winter to mid-spring for both hemispheres (Mollet et al. 2000). Pups are born off the coast of New South Wales around November (Last & Stevens 2009). Litter size is smaller than the shortfin mako, between 2-8 (Compagno 2001). Mako sharks presents an uncommon form of embryonic development called oophagy. During this phase, the embryos inside the uterus develop a large yolk-filled stomach, consuming the unfertilised eggs produced by the pregnant female (Mollet et al. 2000; Jeng Joung & Hsu 2005). The reproductive cycle for mako sharks is 2-3 years, being the 3 years period most likely, meaning an 18-month resting period (Mollet et al. 2000). The mating can occur after parturition (requiring sperm storage) or after the resting period (before ovulation) (Mollet et al. 2000). This low reproductive rate (large amount of energy used in the production of a few well developed and protected litter, and long reproductive cycle periods) is one of the factors that make this species highly susceptible to overfishing (Stevens 1992).

26. *What is the* ***population trend*** *for the entire species?*	
a. *What data are there to indicate* ***past decline*** *in size (if available, include data on rate of decline over past 10 years or 3 generations whichever is longer)?*	There is a paucity of data on population trends for longfin mako, however, fisheries data that group both mako species together and that have evidenced a decline in their catches may prove useful at elucidating trends. In the Northwest Atlantic, analysis of CPUE from the US pelagic longline fishery logbooks reported that *Isurus* spp. may have declined by about 40% in the Northwest Atlantic between 1986-2000 (Baum et al. 2003). A more recent assessment of observer data for the same fishery found a similar instantaneous rate of decline of 38% between 1992-2005 ([redacted]. in prep.). A similar analysis of the same dataset and species grouping that restricted the areas of analysis to account for unbalanced observations, resulted in an overall decline of 48% from the beginning to the end of the time series (1992-2005) (Cortés et al. 2007). In addition, Ferreti et al. (2008) identified a decline of over 96% in mako and four other large shark species in the western and central Mediterranean.
b. *What data are there to indicate* ***future changes*** *in size (if available, include data which will indicate the percentage of decline over 10 years or 3 generations whichever in longer (up to a maximum of 100 years in the future) where the time period is a continuous period that may include a component of the past)?*	There are no data readily available that indicate future changes in the size of longfin mako populations. However, as a pelagic migratory species, they regularly migrate between national jurisdictions and through high sea areas where fishing pressure is extensive and largely unregulated. Longfin mako sharks are therefore vulnerable to global threats which are acting to decrease populations around the world (see Q43).
27. *Does the species undergo* ***extreme natural fluctuations*** *in population numbers, extent of occurrence or area of occupancy? To what extent and why?* **Extreme fluctuations** can be said to occur in a number of taxa when population size or distribution area varies widely, rapidly and frequently, typically with a variation greater than one order of magnitude (i.e. a tenfold increase or decrease).	There is no evidence of extreme natural fluctuations in population numbers of longfin mako sharks. Fluctuations in extent of occurrence appear to be related to declines in population numbers from the effects of anthropogenic threats and influences (see Q43). There are no readily available data that indicate extreme natural fluctuations in the area of occupancy for this species in Australian waters or anywhere in the world, however, such fluctuations might be evidenced in the movements of the species as it migrates between state and national jurisdictions.
28*. What is the* ***generation length*** *and how it is calculated?* **Generation length** is the average age of parents of the current cohort (i.e. newborn individuals in the population). Generation length therefore reflects the turnover rate of breeding individuals in a population. Generation length is greater than the age at first breeding and less than the age of the oldest breeding individual, except in taxa that breed only once. Where generation length varies under threat, the more natural, i.e. pre-disturbance, generation length should be used.	The generation length for the mako shark is estimated using parameters of age of first reproduction and natural mortality rate into the following formula: *GL = age of first reproduction + (1/natural mortality rate)* As the natural mortality rate of longfin mako sharks has not been calculated, it is difficult to determine the generation length for this species. However, this has been calculated for the shortfin mako as follows (COSEWIC 2006): GL = 8+(1/0.16) GL = 14 years
29*. Identify* ***important populations*** *necessary for the species' long-term survival and recovery? This may include:*	There are no data readily available that identifies populations of importance for this species.

key breeding populations, those near the edge of the species' range or those needed to maintain genetic diversity.	
30. *Describe any* ***cross-breeding*** *with other species in the wild, indicating how frequently and where this occurs.*	There is no information available on any cross-breeding of this species with any other in the wild.
31. *Departmental Use only:*	

Populations In Reserve

32. *Which* ***populations*** *are* ***in reserve systems****? Which of these are actively managed for this species? Give details.*	The highly migratory nature of this species means that it is likely to pass through reserve systems within its range. However, given that it is likely to use these habitats only temporarily, they will only provide minimal protection while the individual sharks are within the reserve system boundaries.

Habitat

33*. Describe the* ***species' habitat*** *(e.g. aspect, topography, substrate, climate, forest type, associated species, sympatric species). If the species uses different habitats for different activities (e.g. breeding, feeding, roosting, dispersing, basking), then describe each habitat.*	Specific habitat requirements for the mako shark have not been sufficiently described, however, temperature seems to be the most critical component in defining its distribution. They rarely occur in waters below 16ºC (Compagno 1984; COSEWIC 2006) and prefer warm waters between 17ºC and 22ºC as reported in the North Atlantic (Casey & Kohler 1992), and in the Northern Pacific – Southern California Bight (Holts & Bedford 1993). This is an epipelagic species with a tendency to follow movements of warm waters polewards during summer (Compagno 2001). It has been suggested that female longfin mako sharks may approach land to pup (Compagno 2001).
34. *Does the species use* ***refuge habitat****, e.g. in times of fire, drought or flood? Describe this habitat.*	Longfin mako is an open ocean pelagic shark and does not use refuge habitat.
35. *Is the* ***extent or quality*** *of the species' habitat* ***in decline****? If the species uses different habitats, specify which of these are in decline.*	It is well accepted that the increasing rate of anthropogenic exploitation of the oceans is responsible for population declines and loss of coastal and oceanic biodiversity (Dulvy et al. 2007). However, the extent of these effects has not been yet evaluated directly for the longfin mako.
36. *Is the species part of, or does it rely on, a* ***listed threatened ecological community****? Is it associated with any other* ***listed threatened species****?*	There are no data available on listed TECs that this species is part of or relies on, or any listed threatened species that it is associated with.

Feeding

37*. Summarize the species'* ***food*** *items or sources and timing/seasonality.*	Mako sharks are apex predators. Their main prey consists of teleost fishes, mainly pelagic species such as tuna, bluefish and swordfish (Campana et al. 2005). Makos caught as by-catch in the eastern North Atlantic showed bony fish content in their stomach of 87% (Maia et al. 2006). Their diet also includes crustaceans and cephalopods. Typically their prey is smaller than the shark's body. Studies in South Africa showed a prey size of 10 – 35% of the length of the mako (Compagno 2001), while other studies suggested a prey size average of 22.6% of the size of the predator (Maia et al. 2007). Mako sharks exhibit seasonal variation in their diet, which depends on food availability. This variation is especially marked in juveniles. A study made in the eastern North Atlantic coast of Portugal, showed a preference for crustaceans during the summer when they are abundant (Maia et al. 2007).

38. *Briefly describe the species' **feeding behaviours**, including those that may make the species vulnerable to a threatening process.*	Makos sharks are opportunistic. They feed near the surface and below it (Compagno 2001). Because these sharks require a high metabolic rate to maintain their body temperature (endothermic species), they will feed on larger quantities of prey whenever they are available rather than show a trend on prey selectivity. Therefore, their forging behavior is mainly influenced by prey encounters (Maia et al. 2007). However, this shark habitat overlaps with fishing targets, such as tuna and swordfish Simpfendorfer et al. 2008), increasing its chances of being caught as by-catch in these fisheries (Dulvy et al. 2008).

Movement Patterns (fauna species only)

39. *Describe any relevant **daily and seasonal pattern of movement** for the species, or other irregular patterns of movement, including relevant arrival/departure dates if migratory.*	Juvenile mako sharks spend most of their time (80%) in surface waters (<12 m depth), doing deeper excursions during the daytime (Sepulveda et al. 2004). Another study suggested that juveniles spend almost 90% of their time in the mixed layer with few dives below the thermocline (Holts & Bedford 1993). Adults also spend most of their time in the mixed layer (above 20m in the southern California Bight). The longfin mako is also reported from the surface of the ocean but likely spends more time in deeper waters.
40. *Give details of the species' **home ranges/territories**.*	The distribution of longfin makos is poorly known, however, it seems to be cosmopolitan in tropical and warm temperate waters worldwide (Reardon et al. 2006), and common in the western Atlantic and central Pacific (Compagno 2001).

Survey Guidelines

41. *Give details of the **distinctiveness and detectability** of the species.*	Longfin mako sharks are most similar in appearance and ecology to the closely related shortfin mako. These species can be distinguished on the basis of morphological characteristics. Primarily, long fin mako sharks have pectoral fins that are as long as the head length, and the underside of the snout and jaws are dusky in adults. In contrast, the pectoral fins of shortfin mako are considerably shorter than the head length, and the underside of the snout and jaws are white in adults (Last & Stevens 2009).
42. *Describe **methods for detecting species** including when to conduct surveys (e.g. season, time of day, weather conditions); length, intensity and pattern of search effort; and limitations and expert acceptance; recommended methods; survey-effort guide.*	Much of the data that exist for longfin mako has been derived from fisheries data and catch analyses. Surveys have not been completed for this species.

Section 2 - Threats and Threat Abatement

Threats

43. *Identify **past, current and future threats**, to the species indicating whether they are actual or potential. For <u>each</u> threat, describe:*	Mortality from fishing is the main threat facing mako sharks. By-catch in longline fisheries is the major component of mortality for this species (COSEWIC 2006).
a. ***how and where*** *it impacts on this species;*	Fishing mortality impacts on this species because longline fishing fleets operate in the same habitat range as that of mako sharks. These big vessels typically use thousands of hooks at depth that varies from about 60 to 250 m (Stevens 1992). In the Atlantic swordfish fisheries, mako sharks consist of 7% of total catches (weight), and 10% (weight) of all

	North Atlantic shark catches (Dulvy et al. 2008). According to Dulvy et al. (2008), mako sharks have been experiencing major abundance declines worldwide. Even though there is not enough data related to population status, in some areas this shark is now rarely seen, such as in the eastern Mediterranean Sea. Other areas have experienced major declines, for instance, declines up to 70% have been documented in the North Atlantic Ocean. Data obtained using species-specific logbooks from Japanese longline fleets in the Atlantic Ocean between 1994 and 2006 revealed mean yearly catches of mako sharks of 6,700 animals and 270 t in weight (ICAAT 2008).
b. *what its **effect** has been **so far** (indicate whether it is known or suspected; present supporting information/research; does it only affect certain populations);*	Studies in the Atlantic Ocean on longfin mako shark demonstrated that this shark has a very low productivity and is likely to interact with fisheries, making this shark one of the most vulnerable species to overfishing (Cortes et al. 2008). Even though the impact of overexploitation on this species is poorly known, fishing fleets had reported a decline on their incidental catches. Studies in the North Atlantic on Japanese and US longline had experienced up to 50% declines in their catch rates (COSEWIC 2006).
c. *what is its **expected effect in** the **future** (is there supporting research/information; is the threat only suspected; does it only affect certain populations);*	As there are no management initiatives in place to curb the degree of by-catch of the species, it is expected that the population of longfin mako will continue to decline globally in accordance with the trends that are being evidenced around the world and described above in Q43a and b.
d. *what is the **relative importance or magnitude** of the threat to the species.*	As described above, fishing mortality from by-catch in commercial fisheries is the main cause of population decline for longfin mako.
***44.** If not included above, identify **catastrophic threats**, i.e. threats with a low predictability that are likely to severely affect the species. Identify the threat, explain its likely impact and indicate the likelihood of it occurring (e.g. a drought/cyclone in the area every 100 years).*	As this species' habitat is typically offshore, it is not affected by catastrophic natural events. However, anthropogenic effects on ocean temperatures such as climate change might influence the distribution and habitat of this species (COSEWIC 2006).
***45.** Identify and explain any **additional biological characteristics** particular to the species that are threatening to its survival (e.g. low genetic diversity)?*	As for many others elasmobranchs, longfin mako sharks have life-history characteristics that threaten their capacity to recover from high fishing mortality, such as low population increase rates (Campana et al. 2005; Cortés et al. 2008; Dulvy et al. 2008), and a reproductive strategy of late age at maturity, slow growth and few and well formed offspring (Wood et al. 2007).
***46.** Identify and explain any **quantitative measures or models** that address the probability of the species' extinction in the wild over a particular timeframe.*	Ecological Risk Assessment (also known as Productivity and Susceptibility Analysis) is a tool used to evaluate how vulnerable a stock is to becoming overfished. These analyses are based on the biological productivity of the species (rate of population increase) and how susceptible (or likely) is the species to be overfished (Cortes et al. 2008). Even though this tool does not address the probability of species´ extinction, it provides a range of vulnerabilities for species subject to exploitation.
***47**. Is there **other information** that relates to the survival of this species that you would like to address?*	No.

Threat Abatement and Recovery

***48.** Give an overview of how broad-scale **threats** are **being abated**/could be*	Mortality from fishing is the main threat faced by this species. Given current fishing practices, such as gear, fishing effort, and seasons, the

*abated and **other recovery actions** underway/ proposed. Identify who is undertaking these activities and how successful the activities have been to date.*	only way to decrease the catch of longfin mako sharks is by lowering fishing efforts for targeted pelagic species like tuna and swordfish. However, the trend in effort for these fisheries has been increasing over the last few decades (Figure 2). Fishing gear has a major impact on by-catch. Circle hooks used in longline fisheries have been found to produce higher catch rates of commercial species such as swordfish and tuna, but also produce higher levels of by-catch in sharks (Ward & Hall 2008). Unfortunately, protection of mako sharks is mainly limited to fishery management regulations (COSEWIC 2006). Atlantic pelagic fisheries do not have a quota for by-catch, and even though shark finning is prohibited in many countries, this is a practice that is still occurring.
***49.** For species nominated as extinct in the wild, provide details of the locations in which the **species** occurs **in captivity** and the level of human intervention required to sustain the species.*	Not applicable.

Mitigation Approach

***50.** Describe any **mitigation measures or approaches** that have been developed specifically for the species at identified locations. Identify who is undertaking these activities and how successful the activities have been to date.*	No mitigation measures or approaches have been specifically developed for the species. However, as longfin mako is not commonly targeted for its meat, this species could benefit from international measures to ban the practice of shark finning that have been implemented in nine of the tuna commissions, including the Atlantic (ICCAT), Eastern Pacific (IATTC), and Indian Ocean (IOTC), if they result in the live release of bycatch (Camhi et al. 2008).

***51.** Departmental use only:*	

Major Studies

***52.** Identify major studies on the species that might relate to its taxonomy or management.*	Longfin mako shark has not been well studied worldwide. By comparison, shortfin mako shark has been studied in greater depth, and this information may be useful for ascertaining the ecology, biology and population dynamics of longfin mako sharks. These studies are given below. Campana, S.E; L. Marks, L & W. Joyce, W. (2005). "The biology and fishery of shortfin mako sharks (*Isurus oxyrinchus*) in Atlantic Canadian waters". Fisheries Research **73**: 341-352. Casey, J.G., and N.E. Kohler. (1990). "Long distance movements of Atlantic sharks from the NMFS Cooperative Shark Tagging Program". Discovering Sharks. S.H. Gruber ed. American Littoral Society, Highlands, NJ. 1**9**(4):87-91. < http://na.nefsc.noaa.gov/sharks/move/move.html> Downloaded on 2nd March 2009. Casey, J. G. and N. E. Kohler (1992). "Tagging Studies on the Shortfin Mako Shark (*Isurus oxyrinchus*) in the Western North Atlantic." Australian Journal of Marine and Freshwater Research **43**: 45–60. Compagno, L. J. V. (1984). "Sharks of the World. An annotated and illustrated catalogue of shark species known to date". Volume 4, Part 1: Hexanchilformes to Lamniformes. FAO Species Catalogue. <http://www.fao.org/docrep/009/ad122e/ad122e00.HTM>. Downloaded on 25 February 2009. Compagno, L.J.V. (2001). "Sharks of the World. An annotated and

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Management Documentation

53. *Identify* ***key management documentation*** *available for the species, e.g. recovery plans, conservation plans, threat abatement plans.*	There is no management documentation available for the species.
54. *Departmental use only:*	

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Section 3 – References and Reviewers

Notes:

- The opinion of appropriate scientific experts may be cited (with their approval) in support of a nomination. If this is done the names of the experts, their qualifications and full contact details must also be provided in the reference list below.
- Please provide copies of key documentation/references used in the nomination

55. *Reference list*

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FIGURES

Figure 1 deleted due to copyright

Figure 1. Global Distribution of longfin mako shark (Compagno 2001).

Figure 2 deleted due to copyright

Figure 2. Trend in effort for the North Atlantic longline fleet (1956-1997) (COSEWIC 2006)