



2011 NOMINATION – *Carcharhinus plumbeus*

**Section 1 - Legal Status, Distribution, Biological, Ecological**

**Conservation Theme**

<p><b>1.</b> The conservation themes for the assessment period commencing 1 October 2010 (for which nominations close 25 March 2010) are <b>'heathlands and mallee woodlands', and 'terrestrial, estuarine and near-shore environments of Australia's coast'</b>.</p> <p><i>How does this nomination relate to the <b>conservation themes</b>?</i></p>	<p>The sandbar shark, <i>Carcharhinus plumbeus</i>, is a wide-ranging coastal species in tropical and temperate regions (McAuley et al 2005). It can be found along most of the Western Australian coastline and off northern Queensland coastline extending to at least Port Macquarie, New South Wales (McAuley et al 2007; Macbeth et al. 2009). It is also believed that female sandbar shark approach shallower habitats near land to pup (Brewster-Geisz &amp; Miller, 2000). The nomination for this species is therefore relevant to the current theme of 'near-shore environments of Australia's coast'</p>
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**Taxonomy**

<p><b>2.</b> What are the <b>currently accepted scientific and common name/s</b> for the species (please include Indigenous names, where known)?</p> <p><i>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).</i></p>	<p>Family Carcharhinidae or whaler sharks</p> <p>Scientific Name: <i>Carcharhinus plumbeus</i></p> <p>Common Names:</p> <ul style="list-style-type: none"> <li>• Sandbar shark</li> <li>• Thickskin shark</li> <li>• Brown Shark</li> <li>• Tiburón aletón</li> <li>• Jaquetón</li> </ul>
<p><b>3.</b> Is this <b>species conventionally accepted</b>? If not, explain why. Is there any controversy about the taxonomy?</p>	<p><i>Carcharhinus plumbeus</i> is a conventionally accepted species.</p>
<p><b>4.</b> If the species is <b>NOT conventionally accepted</b>, please provide:</p> <p><i>(i) a taxonomic description of the species in a form suitable for publication in conventional scientific literature; OR</i></p> <p><i>(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.</i></p>	<p>Not applicable</p>
<p><b>5.</b> Is this species <b>taxonomically distinct</b> (Taxonomic distinctiveness – a measure of how unique a</p>	<p>Sandbar shark is closely related to the bignose shark (<i>Carcharhinus altimus</i>), which it may often be mistaken for (Camhi et al. 2007).</p>



species is relative to other species)?

## Legal Status

**6. What is the species' current conservation status under Australian and State/Territory Government legislation?**

Sandbar sharks are not listed under any Australian Federal or State/Territory Government legislation.

In NSW, *Carcharhinus plumbeus*' exploitation status is considered as *Undefined* because of the difficulty related to its identification, especially as juveniles and because of a lack of research working towards a stock assessment (NSW DPI 2008).

**7. 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).**

The sandbar shark is listed as *Vulnerable* on the IUCN Red List of Threatened Species and its population trend is decreasing (Musick et al. 2007).

Family *Carcharhinidae* is listed as *highly migratory* under the 1995 UN Agreement on the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks, UNFSA (Musick et al. 2007), and listed on Annex I, Highly Migratory Species, of UNCLOS.

The 15th Conference of the Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) will take place in March 2010 and will propose to include the Scalloped hammerhead shark (*Sphyrna lewini*) in Appendix II of CITES. Sandbar shark will be considered as a "look-alike" species for *S lewini* fins under this proposal (CITES 2009).



### Description

**8.** 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:

The sandbar shark is a medium sized whaler shark (Figure 1). The first dorsal fin is the distinctive feature that helps to identify the species as it is taller than average and originates anterior to the pectoral axis. They have blunt, rounded snouts that are shorter than the width of the mouth. The upper jaw has broad, triangular, serrated teeth, whilst the teeth on the lower jaw are narrower and more finely serrated. Ventrally the sharks are white and bronze to a blue or brownish grey dorsally (Knickle 2009).

*Image deleted due to copyright requirements*

Figure 1. Sandbar shark appearance (Knickle 2009)

Size, Age, and Growth:

Sandbar sharks can reach a maximum length of 2.4m, but they are 2m and 90kg on average. Sandbar sharks are slow growing and late maturing with a low fecundity. Males reach maturity between 130-180 cm, and females at 145-180 cm. The sandbar shark can weigh from 45-90 kg at the time of maturation, but averages 50 kg for males and 68 kg for females. Size at birth ranges from 55-70 cm (Knickle 2009).

Social structure & Dispersion:

This is a coastal species that occurs principally in the upper zones on the ocean. Sandbar sharks inhabit waters along continental and insular shelves adjacent to deep water from intertidal to 280m deep, but are normally found near the bottom in water depths of less than 100 m (Musick et al. 2007). They are highly migratory and can travel thousands of kilometres every year (McAuley et al. 2005). Sandbar sharks appear to be segregated by depth with mature males being found in greater numbers at depths greater than 110m and mature females in greater numbers at depths less than 36m. Immature individuals are found at all depths but tend to occur at depths between 73 and 109m (McElroy et al. 2006). Male sandbar sharks demonstrate congregated migrations and often travel in large schools while females exhibit solitary migrations (Knickle 2009). Neonate and juvenile sandbar sharks use shallow waters as nursery grounds (Rechisky & Wetherbee 2003).

The Western Australian juvenile population tends to occur in temperate, offshore continental shelf waters rather than shallow waters of estuaries like those of other regions. Mature sized sharks predominately occur in tropical waters (McAuley et al. 2005).

**9.** 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 sandbar shark is an opportunistic bottom-feeder. Its diet includes a wide variety of prey, mainly of teleost fishes, and cephalopods (McElroy et al. 2006; Knickle 2009; McAuley et al. 2005). As a top predator, the sandbar shark plays an important role in structuring marine ecosystems (McAuley et al. 2005). It helps to maintain 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 there remains some uncertainty as to the exact nature of these effects (Stevens et al. 2000). More recently, cascading effects of removing large numbers of sandbar and other large shark species have been documented, with significant ecosystem implications (Myers et al. 2007).

### Australian Distribution

**10. Describe the species' current and past distribution in Australia and, if available, attach a map.**

Sandbar sharks are found along most of the Western Australian coastline and off the northern Queensland coastline extending to at least Port Macquarie in NSW (Fig 2) (Macbeth et al. 2008). This species is not found in the more southern latitudes between Esperance in Western Australia and Port Macquarie in New South Wales. Western Australian stock is mainly distributed between Cape Lavenque in the North, and Point D'Entrecasteaux in the South (McAuley et al. 2005). Also it is apparently less common north of 16°S on either coast (McAuley et al. 2007b). It's therefore believed that these stocks are separate (McAuley et al. 2005).

*Image deleted due to copyright requirements*

Figure 2. Australian distribution of the sandbar shark (Queensland Government 2009).

**11. What is the extent of occurrence (in km<sup>2</sup>) 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 for the Australian distribution of this species is within the exclusive economic zones (EEZs) of the areas described in Q10. Sandbar sharks are found along most of the Western Australian coastline and off the northern Queensland coastline extending to at least Port Macquarie in NSW (Fig 2) (Macbeth et al. 2008). Sandbar sharks are found in water depths ranging from intertidal to 280m, but are normally found near the bottom in waters less than 100 m (Musick et al. 2007). The extent of occurrence of sandbar shark has not been determined in terms of square kilometres.

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)?

In Australia, biomass has decreased to 35% of pre-fishery levels as a result of fishing off Western Australia (Camhi et al. 2007). There are no data available to enable assertions to be made on past declines in extent of occurrence in NSW or NT waters. The population trend for this species is declining worldwide. Sandbar shark has been heavily depleted by fishing pressure in the Northwest Atlantic (Camhi et al. 2007; Myers et al. 2007). In the United States, FAO catch statistics for this species have reported steady declines since 1990 (CITES 2009). In the northwest Atlantic Ocean, stock assessments have found that sandbar sharks have been depleted 64-71% from unexploited population



	<p>levels (CITES 2009). Just on the east coast of the U.S.A., the population was estimated to be declining by more than 7% per year during the mid 1990s and was predicted to eventually collapse (McAuley 2005). In NSW, catches of sandbar shark saw recent rises of 100% following expansion of fishing effort (Macbeth et al. 2009) but a similar level of effort in the most recent season (2008/09) saw catches decline and fishers unable to reach the TAC, potentially indicating an already depleted stock (Bruce, 2010).</p>
<p>c. <i>What data are there to indicate <b>future changes</b> 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)?</i></p>	<p>By 2005, the status of the WA stock showed that sandbar shark catches were unsustainable and the breeding stock has been depleted. McAuley (2005) examined 65 hypothetical scenarios of fishing mortality in the fishing sector that catch this species and only 15 of them gave neutral or positive population growth rates. To achieve the capacity for positive growth in the population and thus reverse the current declining trend in this stock, major reductions in fishing mortality were necessary in both the WA North Coast Shark Fishery and in the temperate demersal gillnet and demersal longline fishery.</p> <p>In NSW, sandbar shark catches in the NSW Ocean Trap and Line Fishery have increase 100% over the last decades (Macbeth et al. 2009). The sandbar shark is the main targeted shark species of this fishery and represents 35% of catches. Thereby, it is expected that the population of sandbar sharks will continue to decline in NSW waters in accordance with the trends that are being evidenced in WA.</p>
<p><b>12. What is the area of occupancy (in km<sup>2</sup>) for the species (described in Attachment A); explain how calculated and datasets that are used.</b></p>	
<p>a. <i>What is the <b>current</b> area of occupancy?</i></p>	<p>This is a coastal and highly migratory species. As neonates they spend their whole time in nursery grounds. Juveniles occupy these nursery grounds but migrate seasonally to warmer water in winter, returning to the nursery grounds during summer. As adults they are highly migratory, and they do not return to the nursery areas, with the exception of near-term pregnant females which give birth in these areas every 2 years (Brewster-Geisz &amp; Miller, 2000). As such, they move throughout the extent of occurrence described in Q11. The area of occupancy of sandbar shark has not been determined in terms of square kilometres.</p>
<p>b. <i>What data are there to indicate <b>past declines</b> in area of occupancy (if available, include data that indicates the percentage decline over the past 10 years or 3 generations whichever is longer)?</i></p>	<p>There are no readily available data that elucidate past declines in the area of occupancy for this species in Australian waters. However, the loss of estuarine and coastal nursery habitats from the destruction of mangrove forests, aquaculture and other coastal developments can compromise the recruitment in this and other shark species (Field et al. 2009).</p>
<p>c. <i>What data are there to indicate <b>future changes</b> in area of occupancy (if available, include</i></p>	<p>Given the lack of available data on the sandbar shark it is not possible to indicate future changes in areas of occupancy.</p>



**Australian Government**

**Department of the Environment**

<p><i>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)?</i></p>	
<p><b>13. How many <i>natural locations</i> do you consider the species occurs in and why? Where are these located?</b> <i>The term 'location' defines a geographically or ecologically distinct area.</i></p>	<p>In Australia, the sandbar shark is distributed on both the east and west coasts (McAuley et al. 2005, McAuley et al. 2007(b), (c)), but it is apparently uncommon north of 16°S on either coast (McAuley et al. 2007(b), (c)) and in South Australian waters. It is therefore considered to be represented by two distinct regional populations (McAuley et al. 2007b).</p>
<p><b>14. Give <i>locations of other populations</i>: 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.</b></p>	<p>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.</p>
<p><b>15. Is the species' <i>distribution severely fragmented</i>? What is the cause of this fragmentation? Describe any biological, geographic, human-induced or other barriers causing this species' populations to be fragmented.</b> <i>Severely fragmented refers to the situation in 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.</i></p>	<p>It is believed that the Western Australian stock is separate from that on the east coast of Australia (McAuley et al. 2005). However, data are not available to suggest the existence of small isolated populations of sandbar sharks anywhere in the world.</p>
<p><b>16. Departmental Use Only:</b></p>	

**Global Distribution**

<p><b>17. Describe the species' <i>global distribution</i>.</b></p>	<p>Sandbar sharks have a cosmopolitan distribution with numerous allopatric populations throughout tropical and warm temperate coastal areas (Heist et al. 1995). Main distribution is in the Mediterranean Sea, Western and Eastern Atlantic, Western and Eastern Indian Ocean and the Western Pacific (Musick et al. 2007) (Figure 3).</p> <p><i>Image deleted due to copyright requirements</i></p>
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	Figure 3. Global Distribution of the sandbar shark (Knickle 2009).
<p><b>18.</b> Give an overview of the <b>global population's</b> size, trends, threats and security of the species outside Australia.</p>	<p>Fisheries data have revealed declines in populations of sandbar shark around the world. Mortality from fishing is the main threat facing sandbar sharks, being a commonly targeted species in directed coastal gillnet and longline fisheries, and as bycatch by pelagic longlines (CITES 2009). Their fins are highly valued among Hong Kong traders and are one of the more common species identified within the international shark fin trade (Clarke et al. 2006).</p> <p>Important sandbar fisheries outside Australia are found in the Northwest, Northeast and Western Central Atlantic, Mediterranean Sea, Northwest and Western Central Pacific, and South China Sea (Camhi et al 2007; Musick et al. 2007; CITES 2009). All of these fisheries have been severely overfished (Musick et al. 2007). For instance, in the Northwest Atlantic, stock assessments have found sandbar sharks have been depleted 64-71% from unexploited population levels (CITES 2009). Myers et al. (2007) cite declines of 87% on the eastern seaboard of the United States. Over the last 20 years, sandbar shark juveniles have been common bycatch caught off the coast of Brazil, in the Southwest Atlantic (Musick et al. 2007).</p> <p><i>Carcharhinus plumbeus</i> is a species of primary importance in the Atlantic and Gulf of Mexico shark fishery. Since the mid 1980s, the demand for this species increased exponentially, and by 1989 this fishery peaked with landings of approximately 4600t dressed weight (Brewster-Geisz &amp; Miller 2000). By the year 1992, sandbar shark landings declined dramatically, with yearly landings between 400 and 700t (dressed weight) until 2007 (Macbeth et al. 2009).</p>
<p><b>19.</b> Explain the <b>relationship</b> between the Australian population and the global population, including:</p>	
<p>a. What <b>percentage</b> of the global population occurs <b>in Australia</b>;</p>	<p>As there are no population estimates for sandbar shark worldwide, it is difficult to determine the percentage of the global population that occurs in Australian waters.</p>
<p>b. Is the Australian population <b>distinct</b>, geographically <b>separate</b> or does part or all of the population move in/out of Australia's jurisdiction (give an overview; details in Movements section);</p>	<p>Sandbar sharks have a cosmopolitan distribution with numerous allopatric populations. This means that populations do not occur in any one place all together, suggesting that the Australian population might be distinct from others. However this is a highly migratory species that can undertake migrations up to 1,000kms in 1 year (Merson &amp; Pratt 2001; MacAuley et al. 2005).</p>
<p>c. Do <b>global threats</b> affect the Australian population?</p>	<p>The migratory nature of this species makes them extremely vulnerable to global threats such as targeted and bycatch commercial fisheries.</p>

**Surveys and Monitoring**

<p><b>20.</b> Has the species been</p>	<p>Records of sandbar shark catches in WA began in 1985/86, however these early records are considered underestimated</p>
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**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.

because fishers did not regularly separate their catches of this species until the mid 1990s. A Fisheries Research and Development Corporation (FRDC) funded a 3-year project on this species commenced in August 2000 with the aim to provide further information on the biology and ecology of the sandbar shark in WA waters. In total, the project sampled 7,387 *Carcharhinus plumbeus* from a variety of commercial gillnet and longline fisheries and a series of fishery-independent longline fishing surveys. In addition, 1,759 sandbar sharks were tagged between August 2000 and June 2004 to study their movements patterns (McAuley et al. 2005).

In the US, the National Marine Fisheries Service (NMFS) Cooperative Shark Tagging Program (CSTP) is a continuing research program directed to the study of the biology of large Atlantic Sharks, including the sandbar shark. Data covering the period from 1963 to 2004 for this species in the western north Atlantic was used to get information on the number of males and females tagged and recaptured, overall recapture rate, maximum distance travelled and time at liberty, and migration patterns for life history stages. A total of 25,968 sandbar sharks were tagged along the U.S east coast and the Gulf of Mexico between 1963 and 2004, and 1,340 were recaptured during this period, with an overall recapture rate of 5.2% (Kohler et al. 2005).

Population size has not been determined. For distribution refer to Q10 and Q17.

**21.** 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

**22.** Is there an ongoing **monitoring programme**? If so, please describe the extent and length of the programme.

Almost all the studies are fishery-based and most of them are for WA waters. A comprehensive, multi-jurisdictional stock assessment is required to determine the sustainable harvest of this shark from eastern and western Australian waters (Macbeth et al. 2009).

A recent observer-based report of targeted commercial fishing for large shark species in northern NSW indicated that the sandbar shark was the main target species, comprising the vast majority of the catches (~35%) during summer, autumn and early-winter months. A total of 81 fishing trips were observed between September 2008 and June 2009, reporting a total number caught of 569 sandbar sharks. However, this species was also caught in northern NSW waters during unobserved trips, increasing the catch number up to 980 individuals. In addition, a report on catches of sharks in the NSW Ocean Trap and Line fishery during the past decade, showed an increase of 100% on sandbar catches (Macbeth et al. 2009).

Also refer to Q20.





## Life Cycle and Population

<p><b>23.</b> <i>What is the species' total population size in terms of <b>number of mature individuals</b>? How were population estimates derived and are they reliable? Are there other useful measures of population size and what are they?</i></p> <p>In the absence of figures, terms such as common, abundant, scarce can be of value.</p>	<p>There have been no population estimates completed for sandbar shark anywhere in the world. Fisheries data have, however, provided estimates of decline in global populations (see Q18).</p>
<p><b>24.</b> <i>Does the species occur in a <b>number of smaller populations</b>? 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?</i></p> <p><b>Subpopulations</b> are defined as geographically or otherwise distinct groups in the population between which there is little demographic or genetic exchange.</p>	<p>Sandbar shark have a cosmopolitan distribution with numerous populations occurring simultaneously in different locations (Merson &amp; Pratt 2001; McAuley et al. 2005). In Australia, it is believed that the WA stock is separate from that on the east coast of Australia (McAuley et al. 2005).</p>
<p><b>25.</b> <i>Provide details on ages of the following:</i></p>	
<p><b>a.</b> <i>sexual maturity;</i></p>	<p>Size at sexual maturity and maximum size vary with location (Saidi et al. 2005). The Western Australian sandbar shark population reaches sexual maturity at smaller sizes (127 cm FL and 136 cm FL for males and females, respectively) than populations elsewhere, specially compared to the western North Atlantic and western Indian Ocean populations. However age at maturity (14 years and 16 years, for males and females, respectively) does not to differ between populations.</p>
<p><b>b.</b> <i>life expectancy;</i></p>	<p>The sandbar shark's life expectancy is estimated to be 30 to 40 years (McAuley et al. 2005).</p>
<p><b>c.</b> <i>natural mortality.</i></p>	<p>The author is not aware of published data on the natural mortality of sandbar sharks.</p>
<p><b>26. Reproduction</b></p>	
<p><b>For animals:</b> <i>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?</i></p>	<p><i>Carcharhinus plumbeus</i> is a placental viviparous species (Saidi et al 2005). Females reproduce biennially and give birth in the spring and summer. Litter size ranges from 4 to 10 (mean 6.9), a number not significantly different from reports on other sandbar sharks elsewhere (Saidi et al 2005). Age of first reproduction is 16 for females and 14 for males (McAuley et al. 2005), and gestation period varies between 9 and 12 months (Pogonoski et al. 2002). In the northern hemisphere, mating occurs in the spring or early summer (May-June). Sharks in the southern hemisphere, in correlation with the warmer summer season, mate in late October to January (Knickle, 2009).</p> <p>Females utilise inshore nursery areas such as shallow bays and estuaries to give birth during summer (Wetherbee et al. in press,</p>



	<p>McAuley et al. 2005). Neonates, juveniles, and near-term pregnant females, spend most of their time in these nursery grounds, such as shallow bays and estuaries, where they feed and protect themselves from predation.</p> <p>As a result of this, in WA there is a relatively high abundance of juvenile sandbar sharks that are vulnerable to capture in the WA demersal gillnet fishery (McAuley et al. 2005). Sandbar shark is also a slow-growing and late maturing species and thus recovery times from periods of overexploitation would be considerable (MacAuley et al. 2005).</p>
<p><b>27. What is the <i>population trend</i> for the entire species?</b></p>	
<p>a. What data are there to indicate <b>past decline</b> in size (if available, include data on rate of decline over past 10 years or 3 generations whichever is longer)?</p>	<p>The population trend for <i>C. plumbeus</i> is declining worldwide. On the east coast of the U.S.A., the population was estimated to be declining by more than 7% per year during the mid 1990s and was predicted to eventually collapse (McAuley 2005). In Western Australia, reported catch of sandbar sharks in the target shark fisheries increased by 60% to 413 tonnes in 2003/04 (McAuley 2005). Current total biomass is estimated to be at approximately 35% of its level prior to the start of full-time northern shark fishing (Musick et al 2007). The species is assessed as Near Threatened throughout Australian waters, close to meeting the criteria for Vulnerable (Musick et al 2007).</p> <p>Given the high intrinsic vulnerability of this species to depletion, significant declines estimated and suspected in several areas of its range and inferred declines in highly fished areas from which data are not available, <i>C. plumbeus</i> has been assessed by IUCN as being Vulnerable globally (Musick et al 2007).</p>
<p>b. What data are there to indicate <b>future changes</b> in size (if available, include data which will indicate the percentage of 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)?</p>	<p>Given the lack of available data on the sandbar shark it is not possible to indicate future changes in the population.</p>
<p><b>28. Does the species undergo extreme natural fluctuations in population numbers, extent of occurrence or area of occupancy? To what extent and why?</b>  <b>Extreme fluctuations</b> 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).</p>	<p>There are no readily available data that indicates extreme natural fluctuations in the extent of occurrence or area of occupancy for this species in Australian waters or anywhere in the world.</p>
<p><b>29. What is the <i>generation length</i> and how it is calculated?</b>  <b>Generation length</b> is the average age of</p>	<p>The generation length for the sandbar shark is estimated using parameters of age of first reproduction and natural mortality rate (as for mako sharks in COSEWIC 2006) into the following</p>



<p>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.</p>	<p>formula:</p> $GL = \text{age of first reproduction} + (1/\text{natural mortality rate})$ <p>Age of first reproduction was taken from MacAuley et al. (2005), and natural mortality was taken from Brewster-Geisz &amp; Miller (2000).</p> <p>In the case of female sandbar shark,</p> $GL = 16 + (1/0.1)$ <p><b>GL = 26</b></p> <p>In the case of male sandbar shark,</p> $GL = 14 + (1/0.1)$ <p><b>GL = 24</b></p>
<p><b>30. Identify <i>important populations</i> necessary for the species' long-term survival and recovery? This may include: key breeding populations, those near the edge of the species' range or those needed to maintain genetic diversity.</b></p>	<p>Sandbar sharks spend a significant part of their lives in protected estuaries and bays. They use these shallow coastal areas as nursery grounds in which they protect themselves from predators and environmental conditions. As neonates they spend their whole time in these areas. Then as juveniles, they occupy these nursery grounds intermittently throughout the year, with seasonal migrations. Adults do not return to the nursery areas with the exception of near-term pregnant females which give birth in these areas every 2 years (Sminkey &amp; Musick, 1995; Carlson, 1999; Brewster-Geisz &amp; Miller, 2000; Merson &amp; Pratt, 2001).</p> <p>Often neonate and young juveniles are considered the most critical age classes in terms of population stability/recovery, but evidence also suggests life stages outside the nursery are crucial in managing shark populations. However, due to the migratory nature of many shark species, protecting nursery grounds during early life stages has become the easier way to focus resources and strategies on the management of a particular environment. Nursery ground protection should remain a component in shark management strategies, nevertheless it is critical to link early life stage conservation with management strategies that include older individuals residing outside these areas to achieve effective management. The effects of depleted adult populations have direct impacts on neonate and juveniles populations because of the relationship that exists between breeding population size and recruitment (Kinney &amp; Simpfendorfer 2009).</p>
<p><b>31. Describe any <i>cross-breeding</i> with other species in the wild, indicating how frequently and where this occurs.</b></p>	<p>There is no evidence of cross-breeding with any other species in the wild.</p>
<p><b>32. Departmental Use only:</b></p>	

**Populations In Reserve**

<p><b>33. Which <i>populations</i> are in</b></p>	<p>No species-specific mechanisms are currently in place to manage</p>
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**reserve systems?** Which of these are actively managed for this species? Give details.

particular populations of the sandbar sharks, though sharks in general may be afforded some protection in reserve systems.

In Australian waters, all reserve systems in the species range may have sandbar sharks occurring either permanently or occasionally. Sandbar sharks are found along most of the Western Australian coastline and off the northern Queensland coastline extending to at least Port Macquarie in NSW (Macbeth et al. 2008). Possible reserve systems in which sandbar sharks may occur include:

- Ningaloo Marine Park is located along the coast of WA. The park covers 5076km<sup>2</sup> and includes both Commonwealth Waters (2436km<sup>2</sup>) and State Waters (2640 km<sup>2</sup>).
- Mermaid Reef Marine National Nature Reserve is located about 300 km north-west of Broome. The total area of the Marine National Nature Reserve is 53,984 hectares and the declaration includes the seabed and subsurface to a depth of 1000m.
- Ashmore Reef National Nature Reserve is located in the Timor Sea about 840 km west of Darwin and 610 km north of Broome. It includes 583 square km of seabed, three small islands, a large reef shelf and surrounding waters. The reef platform is at the edge of the North-west Shelf and covers an area of 239 km<sup>2</sup>.
- Cartier Island Marine Reserve is located 350 km off Australia's Kimberley coast, 115 km south of the Indonesian island of Roti and 45 km from Ashmore Reef. It covers an area of 167 km<sup>2</sup>.
- The Great Barrier Reef stretches 2,300 kms along the Queensland coastline and includes over 2,900 reefs, around 940 islands and cays. The Great Barrier Reef Marine Park covers an area of 345,000 km<sup>2</sup>.
- The Coringa-Herald National Nature Reserve is located in the Coral Sea, about 400 km east of Cairns, and it covers an area of 8856 km<sup>2</sup>.
- The Lihou Reef National Nature Reserve is located in the Coral Sea, about 630 km east south-east of Cairns, far north Queensland. The reserve covers an area of 8440 km<sup>2</sup>.
- Solitary Islands Marine Reserve (SIMR) and Solitary Islands Marine Park (SIMP) is located off the coast of Northern NSW 600 km north of Sydney between Coffs Harbour and Plover Island. The SIMR covers an area of 160 km<sup>2</sup>, and the SIMP an area of 710 km<sup>2</sup>. Both cover an area of 870 km<sup>2</sup>.
- Moreton Bay Marine Park in Queensland State waters covers 3400 km<sup>2</sup> and stretches 125km from Caloundra to the Gold Coast.
- Cape Byron Marine Park in NSW State waters covers approximately 22 000 hectares, extending from Brunswick Heads in the north to Lennox Head in the south.



Image deleted due to copyright requirements

Figure 4. Marine protected of Australia (DEWHA 2009).

### Habitat

<p><b>34. Describe the <i>species' habitat</i></b> (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.</p>	<p><i>Carcharhinus plumbeus</i> is an inshore-offshore, coastal-pelagic shark of temperate and tropical waters. It inhabits continental and insular shelves and adjacent deep water from the intertidal zone to a depth of 280m. They are a bottom dwelling species and are common at bay and river mouths, in harbours, and inside shallow muddy or sandy bays (Pogonoski et al. 2002; Kohler et al. 2005).</p> <p>Within its range, the sandbar shark undertakes seasonal migrations to and from summer feeding and nursery grounds (Ellis &amp; Musick 2007). Some stocks migrate seasonally, often in large schools, as water temperatures change. Young form mixed-sex schools on shallow coastal nursing grounds, moving into deeper, warmer water in winter (Shark Specialist Group 2007).</p> <p>Juvenile sharks use estuaries and bays as nursery grounds (Sminkey and Musick, 1995, Carlson, 1999, Merson &amp; Pratt, 2001) whilst mature females use them as birthing areas. Sharks along the West Australian coastline tend to use the temperate offshore waters, while adults tend to be found in the tropical waters (McAuley et al. 2005).</p>
<p><b>35. Does the species use <i>refuge habitat</i></b>, e.g. in times of fire, drought or flood? Describe this habitat.</p>	<p>The sandbar shark is a coastal species and does not use refuge habitat.</p>
<p><b>36. Is the <i>extent or quality</i> of the species' habitat <b>in decline</b>?</b> If the species uses different habitats, specify which of these are in decline.</p>	<p>Sandbar sharks require shallow coastal areas as nurseries protected from large predators and environmental conditions. Juveniles remain in these areas during their early development. As such, the loss of estuarine and coastal nursery habitats from the destruction of mangrove forests, aquaculture and other coastal developments can compromise the recruitment in this species. The continuing loss of these habitats could exacerbate the extinction risk of associated species in addition to direct threats of overfishing (Field et al. 2009).</p>
<p><b>37. Is the species part of, or does it rely on, a <i>listed threatened ecological community</i>?</b> Is it associated with any other <b>listed threatened species</b>?</p>	<p>There are no data readily available on specific listed TECs that this species is part of or relies on, or any listed threatened species that it is associated with. However, as a top predator it is possible that the decline of sandbar sharks in the marine environment could trigger trophic-cascades due to species decline affecting a range of threatened species.</p>

### Feeding

<p><b>38. Summarize the species' <i>food items or sources and timing/seasonality</i>.</b></p>	<p>Sandbar sharks are opportunistic bottom-feeders with their diet mainly being composed of teleosts, cephalopods and crustaceans (McElroy et al. 2006, Knickle, 2009; McAuley et al. 2005).</p>
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	Throughout all stages of life, small bony fish are a major component of their diet along with cephalopods, however, Sandbar sharks undergo clear ontogenetic changes in diet, with elasmobranchs and cephalopods increasing in importance with shark size, while crustaceans decrease in importance (McElroy et al 2006; Ellis 2003; Ellis & Musick 2007).
<b>39.</b> Briefly describe the species' <b>feeding behaviours</b> , including those that may make the species vulnerable to a threatening process.	Sandbar sharks undertake ontogenetic changes in diet, with increasing incorporation of elasmobranchs and cephalopods in diet with size and decreasing predation on crustaceans. (Ellis 2003; Ellis & Musick 2007). Teleosts remain a general prey throughout the lifespan, however, types and sizes of fishes consumed may change (Ellis 2003).  Neonates, juveniles and near-term pregnant females use nursery areas to feed. This makes them vulnerable to fishing mortality due to interaction with fisheries. This has been recorded worldwide, in places such as WA (McAuley et al, 2005), the Mediterranean (Saidi et al. 2005), Northeast Atlantic (Wetherbee et al. in press), and the Southwest Atlantic (Musick et al. 2007).

### Movement Patterns (fauna species only)

<b>40.</b> Describe any relevant <b>daily and seasonal pattern of movement</b> for the species, or other irregular patterns of movement, including relevant arrival/departure dates if migratory.	Neonates remain in this stage for a year, and inhabit nursery grounds throughout this entire period, with no seasonal migrations. Juveniles are the first stage to show a seasonal pattern of movement, migrating in winter to warmer waters, and then returning to the nursery ground at summer. This seasonal migration pattern continues until they are between 6 and 10 years old. Once they are subadults, they follow the adult migration pattern, which follows the warmer waters without returning to the nursery grounds, with the exception of near-term pregnant females, which alternate between pregnant and resting stage, spending 1 year in each (Fig 5) (Brewster-Geisz & Miller, 2000).  <i>Image deleted due to copyright requirements</i>  Fig 5. Diagram of the five-stage model. Arrows indicate individuals surviving and growing to the next stage or surviving and remaining in the same stage (Brewster-Geisz & Miller 2000).  In WA, tagging data suggests that juveniles born southwest remain in temperate waters for several years and slowly migrate northwards to join the breeding stock in the north-west as subadults or adults (McAuley et al. 2005).  The dispersal rates of several tagged sharks demonstrated that sandbar sharks might undertake migrating distances of over 1,000 km in less than a year (Merson & Pratt 2001; McAuley et al. 2005), and the USA National Marine Fisheries Service have reported migrations of over 2,900 kilometres for this species (Merson & Pratt 2001), confirming the highly migratory nature of this shark.
<b>41.</b> Give details of the species' <b>home ranges/territories</b> .	Sandbar sharks are found along most of the Western Australian coastline and off the northern Queensland coastline extending to at least Port Macquarie in NSW (Fig 2) (Macbeth et al. 2008).



This species is not found in the more southern latitudes between Esperance in Western Australia and Port Macquarie in New South Wales. Western Australian stock is mainly distributed between Cape Lavenue in the North, and Point D'Entrecasteaux in the South (McAuley et al. 2005). Also it is apparently less common north of 16°S on either coast (McAuley et al. 2007b). It is therefore believed that these stocks are separate (McAuley et al. 2005).

(See Figure 2 - Australian distribution of the sandbar shark (Queensland Government 2009).)

Sandbar sharks are highly migratory and can travel thousands of kilometres every year (McAuley et al. 2005). They appear to be segregated by depth with mature males being found in greater numbers at depths greater than 110m and mature females found in greater numbers at depths less than 36m. Immature individuals are found at all depths but tend to occur at depths between 73 and 109m (McElroy et al. 2006). Male sandbar sharks demonstrate congregated migrations and often travel in large schools while females exhibit solitary migrations (Knickle 2009). Neonate and juvenile sandbar sharks use shallow waters as nursery grounds (Rechisky & Wetherbee 2003).

## Survey Guidelines

**42. Give details of the distinctiveness and detectability of the species.**

Sandbar sharks are a distinctive species. Sandbar sharks look similar in appearance to Dusky sharks (*Carcharhinus obscurus*) but can be identified by their large and tall dorsal fin. This characteristic, and the fact that it's a coastal species, are one of the reasons why this is a common targeted species by fisheries, making them more vulnerable to interact with fishing gear. Sandbar shark is closely related to the bignose shark (*Carcharhinus altimus*), which it may often be mistaken for (Camhi et al. 2007).

**43. 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 sandbar shark has been derived from fisheries data and catch analyses, as well as survey results from tagging studies.

Sampling for the FRDC project in WA (refer to Q20), was conducted from August 2000 to June 2003 throughout the entire length of each year. Staff observed 1,195 gillnet sets over 756 days and 540 longline sets over 348 days. Most of the sharks were caught by demersal gillnets and a small number were caught by demersal longlines (McAuley et al. 2005).

Acoustic telemetry is used to obtain information on movements of individual sharks. Juvenile and adult sandbar sharks are usually tagged on-board commercial gillnet and longline shark fishing vessels and during fishery-independent longline fishing surveys. Sharks are commonly tagged with Jumbo Rototags in the first dorsal fin, and with a dart tag ("M" tag) near the base of the first dorsal fin (Kohler et al. 2005; McAuley et al. 2006; Wetherbee et al. in press).



## Section 2 - Threats and Threat Abatement

### Threats

<p><b>44. Identify <i>past, current and future threats</i>, to the species indicating whether they are actual or potential. For <u>each</u> threat, describe:</b></p>	<p>Mortality from fishing is the main threat facing sandbar sharks. This species is commonly targeted in directed coastal gillnet and longline fisheries and occasionally caught as bycatch by pelagic longlines (CITES 2009). In addition, sandbar shark fins are highly valued among Hong Kong traders and are one of the more common species identified within the international shark fin trade (Clarke et al. 2006). Their fins are generally considered to be of high value, comparable to dusky shark and hammerhead fins (████████ unpubl. Data, from Musick et al 2007).</p>
<p>a. <b>how and where</b> it impacts on this species;</p>	<p>In Australia, the West Coast Demersal Gillnet and Demersal Longline Interim Managed Fishery and the Joint Authority Southern Demersal Gillnet and Demersal Longline Managed Fishery are gear-based fisheries directed primarily at sharks, including <i>C. plumbeus</i>. The catch of sandbar sharks in WA consists primarily of juveniles and has shown an increasing trend since the mid 1990s (McAuley 2006). Other smaller shark fisheries operating in Australia are the Western Australian North Coast Shark Fishery (WANCSF), and the Joint Authority Northern Shark Fishery (JANSF). These shark fisheries land mostly whaler shark species, including sandbar sharks (Borg &amp; McAuley 2004). The NSW Ocean Trap and Line Fishery targets large, mature sharks, principally sandbar and dusky whalers (<i>Carcharhinus obscurus</i>).</p> <p>A number of bycatches have been reported in some fisheries including The Pilbara Fish Trawl Interim Managed Fishery, and the <i>Northern inshore gillnet fisheries</i> (these are the Kimberley Gillnet and Barramundi Managed Fishery). Important sandbar fisheries are also found in the western North Atlantic, eastern North Atlantic, Mediterranean Sea, Northwest and Western Central Pacific, and South China Sea (Musik et al. 2007; CITES 2009).</p>
<p>b. <b>what its effect</b> has been <b>so far</b> (indicate whether it is known or suspected; present supporting information/research; does it only affect certain populations);</p>	<p>The catch of <i>C. plumbeus</i> in the Western Australian shark fishery has risen dramatically since 1997 (Pogonoski et al. 2002). Sandbar catches for these fisheries more than doubled between 1985/86 and 2003/04 to over 200t a year (Fig 6) (McAuley 2006). A formal stock assessment of sandbar sharks, which was completed in April 2005, indicated that the combined levels of WA catch in 2001/02, 2002/03 and 2003/04 were unsustainable, with a breeding stock reported as depleted (McAuley et al. 2005). This species' biomass has decreased to ~35% of pre-fishery levels as a result of fishing off Western Australia (Musick et al 2007). Between 1999/00 and 2003/04, reported catches of <i>C. plumbeus</i> in the WANCSF were between 41% and 49% of the catches (McAuley et al. 2005).</p> <p>In the NSW Ocean Trap and Line Fishery sandbar shark catches have increased by 100% over the last decade. Sandbar shark is the main targeted shark species of this fishery and represents 35% of catches (Macbeth et al. 2009). Recent declines in catches may indicate depletion, and the focus on large, mature sharks, whose fins fetch higher prices, is likely to mean a very low</p>





	<p>sustainable yield (Bruce 2010).</p> <p>Worldwide data has also suggested sandbar shark population decreases. This species has been heavily depleted by fishing pressure in the Northwest Atlantic (Camhi et al 2007). In the United States, FAO catch statistics for this shark have reported steadily declines since 1990 (CITES 2009). In the northwest Atlantic Ocean, stock assessments have found sandbar sharks have been depleted 64-71% from unexploited population levels (CITES 2009).</p> <p><i>Image deleted due to copyright requirements</i></p> <p><b>Figure 6.</b> Annual catches of target shark species in the demersal gillnet and longline fisheries (JASDGDLF and WCDGDLF) for the period 1975/76 to 2003/04 (McAuley 2006).</p>
<p>c. what is its <b>expected effect in the future</b> (is there supporting research/information; is the threat only suspected; does it only affect certain populations);</p>	<p>Sandbar sharks have one of the lowest intrinsic rates of population increase of any shark species yet evaluated (McAuley et al. 2006). Some management initiatives have been put in place (refer to Q49). However, the WA population of sandbar sharks has had a lower than expected capacity to withstand fishing pressure. The combination of biological characteristics results in a slow replacement potential. Without the appropriate management, it is expected that the population of this shark will continue to decline in accordance with the trends that are being evidenced around the world and described above in Q11b.</p>
<p>d. what is the <b>relative importance or magnitude</b> of the threat to the species.</p>	<p>As described above, fishing mortality in commercial target fisheries is the main cause of population decline for the sandbar shark.</p>
<p><b>45.</b> If not included above, identify <b>catastrophic threats</b>, 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).</p>	<p>As this species' habitat is typically offshore, it is not generally thought to be affected by catastrophic natural events. However, anthropogenic effects on ocean temperatures such as climate change may influence the distribution and habitat of this species.</p>
<p><b>46.</b> Identify and explain any <b>additional biological characteristics</b> particular to the species that are threatening to its survival (e.g. low genetic diversity)?</p>	<p>As for many other elasmobranchs, sandbar sharks have life-history characteristics that threaten their capacity to recover from high fishing mortality, such as low population growth rates (estimated population doubling time is approximately 23 years), a reproductive strategy of late age at maturity, relatively small litters, and a 2 year breeding frequency (Borg &amp; MacAuley 2004; MacAuley 2005; MacAuley et al. 2005, CITES 2009). In addition, sandbar shark possess a particularly large dorsal fin that increases its chances to interact with fishing gear and increases its attractiveness to fishers targeting sharks for their fins.</p> <p>Results from studies have confirmed that <i>C. plumbeus</i> has one of the lowest intrinsic rates of population increase of any shark species yet evaluated (McAuley et al. 2006).</p> <p>Fishbase (<a href="http://www.fishbase.org">www.fishbase.org</a>) assigns very high vulnerability and</p>



	very low resilience to sandbar sharks.
<b>47.</b> <i>Identify and explain any <b>quantitative measures or models</b> that address the probability of the species' extinction in the wild over a particular timeframe.</i>	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) the species is to be overfished (Camhi et al. 2007; Cortes et al. 2009). Even though this tool does not address the probability of a species' extinction, it provides a range of vulnerabilities for species subject to exploitation. In addition, Field et al. (2009) have assessed the susceptibility of sharks to extinction.
<b>48.</b> <i>Is there <b>other information</b> that relates to the survival of this species that you would like to address?</i>	The author is not aware of any additional relevant published data available.

### Threat Abatement and Recovery

<b>49.</b> <i>Give an overview of how broad-scale <b>threats</b> are <b>being abated</b>/could be abated and <b>other recovery actions</b> underway/proposed. Identify who is undertaking these activities and how successful the activities have been to date.</i>	<p>Musick et al (2007) stated that sandbar sharks are an important component of the Western Australian shark fishery, with current total biomass at approximately 35% of its level prior to the start of full-time northern shark fishing. They suggested that the implementation of management arrangements in the fishery should arrest any further declines in stock biomass, but reiterated that continued monitoring and assessment will be essential to monitor the stock, and the effectiveness of these measures.</p> <p>The Joint Authority Southern Demersal Gillnet and Demersal Longline Managed Fishery (JASDGDLF) was declared a limited entry fishery in 1988 and is jointly managed by the WA and Commonwealth Governments. The fishery is primarily managed through effort controls in the form of time/gear units, which allow fishers to use one net or an equivalent number of hooks per month.</p> <p>The West Coast Demersal Gillnet and Demersal Longline Interim Managed Fishery (WCDGDLF) is managed as a limited entry fishery, under an interim management plan introduced in 1997. Under the interim plan, the fishery is managed using effort controls in the form of time/gear units.</p> <p>Management measures related to the sandbar shark recently introduced for both fisheries include:</p> <ul style="list-style-type: none"> <li>• Improved management arrangements for shark caught in commercial fisheries that do not target shark;</li> <li>• Improved management measures for recreational fishers, including maximum size limits for all whaler sharks in the west coast and south coast bioregions;</li> <li>• Longline gear restrictions to restrict the use of longlines to target large sharks and reduce the mortality of any incidental catch of large sharks;</li> <li>• The "Days Fished" Scheme of Entitlement. Monthly effort controls (where the value of a unit of entitlement is a set length of demersal gillnet or number of hooks on a demersal longline, fished during a calendar month) were changed to days fished arrangements in the WCDGDLF (where a unit of</li> </ul>
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	<p>entitlement permits a set amount of gear to be used for a maximum number of days per season). This will be introduced in the JASDGDLF in 2009. Currently, a unit of entitlement allows: JASDGDLF license holders to use either 270 m of demersal gillnet (15 or 20 mesh drop) or 90 demersal longline hooks during a calendar month, although there are a small number of units that permit the use of 378 m of gillnet per month (a 'days fished' scheme will be introduced in the JASDGDLF in 2009); and WCDGDLF permit holders to fish for 12 days by means of 270 m of demersal gillnet or 9 hooks on a demersal longline for a fishing season (1 June – 31 May); and</p> <ul style="list-style-type: none"> <li>• Development and implementation of an effort management regime aimed at reducing and constraining effort in the fishery at sustainable levels (DEWHA 2009a).</li> </ul> <p>In 2005, the WA Government introduced a number of changes in all commercial fisheries to reduce mortality for shark species, especially the dusky shark and the sandbar shark. This included the closure of nearly 60% of the fishery to protect breeding stock and putting a limit on the allowed number of fishing days (200 gillnet and 100 longline fishing days for the WANCSF and 400 gillnet and 200 longline days for the WAJANSF) (Wilson et al. 2009).</p> <p>For identification and educational purposes, the FRDC project "<i>Biology and stock assessment of the thickskin (sandbar) shark, Carcharhinus plumbeus, in Western Australia and further refinement of the dusky shark, Carcharhinus obscurus, stock assessment</i>" has produced a shark species guide for fishers of tropical shark species (Shark Advisory Group 2004).</p>
<p><b>50.</b> For species nominated as extinct in the wild, provide details of the locations in which the <b>species</b> occurs <b>in captivity</b> and the level of human intervention required to sustain the species.</p>	<p>Not applicable</p>

### Mitigation Approach

<p><b>51.</b> Describe any <b>mitigation measures or approaches</b> 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.</p>	<p>Industry &amp; Investment (I&amp;I) NSW implemented specific conditions and restrictions on shark fishing in the NSW Ocean Trap and Line fishery during 2008/09 that included a total allowable commercial catch (TACC) for large shark species (including <i>Carcharhinus plumbeus</i>), maximum catch limits for individual TACC shark fishing trips, and a restricted permit for fishers specifically targeting the sandbar shark. A TACC of 100 tonnes has been established for the sandbar shark to be caught via a restricted permit system (sandbar-permit shark fishery).</p> <p>Sandbar-permit fishers have been subject to additional conditions:</p> <ul style="list-style-type: none"> <li>- host an I&amp;I NSW observer during fishing trips when requested;</li> <li>- each pay a permit fee to fund I&amp;I NSW observer work onboard OTL vessels targeting sharks;</li> <li>- inform I&amp;I NSW (via the local Fisheries Officers) of impending shark fishing trips at least one hour (eventually changed to six</li> </ul>
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hours) prior to departing port (Macbeth et al. 2009).

Further restrictions may be applied for the Ocean Trap and Line Fishery to be granted a Wildlife Trade Operation (WTO), with a CSIRO Review (Bruce 2010) indicating the TAC was not precautionary.

In 2005 the WANCSF closed about 60% of the fishery to protect sandbar shark breeding stock and put limits on the permitted number of fishing days (200 gillnet and 100 longline fishing days). A limit of 400 gillnet and 200 longline fishing days was established also for the WAJANSF (Wilson et al. 2009).

For more on WA refer to Q50.

It is crucial to point out that management strategies must include plans for the protection of both young age classes in nursery areas and older members of the population beyond nurseries areas (Kinney & Simpfendorfer 2009).

**52. Departmental use only:**

**Major Studies**

**53. Identify major studies on the species that might relate to its taxonomy or management.**

Brewster-Geisz KK & Miller TJ (2000). Management of the sandbar shark, *Carcharhinus plumbeus*: implications of a stage-based model. Fisheries Bulletin (98): 236-249. <<http://fishbull.noaa.gov/982/02.pdf>> Downloaded 15 Dec 2009.

Macbeth WG, Geraghty PT, Peddemors VM and Gray CA (2009). Observer-based study of targeted commercial fishing for large shark species in waters off northern New South Wales. Industry & Investment NSW –Fisheries Final Report Series No. 114

McAuley, R, R. Lenanton, J. Chidlow, R. Allison & E. Heist (2005). Biology and stock assessment of the Thickskin (sandbar) sharks, *Carcharhinus plumbeus*, In Western Australia and further refinement of the dusky shark, *Carcharhinus obscurus*, stock assessment, Final FRDC Report- Project 2000/134, Fisheries Research Report No. 151, Department of Fisheries, Western Australia, 132p.

McAuley, RB (2006). Demersal gillnet and longline fisheries status report. Department of Fisheries, Perth, Western Australia. <<http://www.fish.wa.gov.au/docs/sof/2004/sof20042005-0503-08.pdf>> Downloaded 15 December 2009

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Recapture Data for the Sandbar Shark, *Carcharhinus plumbeus*, and the Blacktip Shark, *Carcharhinus limbatus*, in the Western North Atlantic (DRAFT). NOAA, National Marine Fisheries Service <[http://www.sefsc.noaa.gov/sedar/download/LCS\\_DW\\_29.pdf?id=DOCUMENT](http://www.sefsc.noaa.gov/sedar/download/LCS_DW_29.pdf?id=DOCUMENT)> Downloaded 11 January 2010

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McAuley RB., Simpfendorfer, C. A., Hyndes, G. A., and Lenanton, R. C. J. (2007). Distribution and reproductive biology of the sandbar shark, *Carcharhinus plumbeus* (Nardo), in Western Australian waters. *Marine and Freshwater Research* 58, 116–126.

Musick, J.A., Stevens, J.D., Baum, J.K., Bradai, M., Clò, S., Fergusson, I., Grubbs, R.D., Soldo, A., Vacchi, M. & Vooren, C.M. (2007). *Carcharhinus plumbeus*. In: IUCN 2009. IUCN Red List of Threatened Species. Version 2009.2. <<http://www.iucnredlist.org/apps/redlist/details/3853/0>>. Downloaded 16 November 2009

Pogonoski, J.J., Pollard, D.A. and Paxton, J.R. (2002). *Conservation Overview and Action Plan for Australian Threatened and Potentially Threatened Marine and Estuarine Fishes*. Environment Australia, Canberra, Australia. <<http://www.deh.gov.au/coasts/publications/marine-fish-action/index.html>> Doenloaded 20 Novcember 2009

Wetherbee BM, Rechisky EL, Pratt HL & McCandless CT (in press). Use of Telemetry in Fisheries Management: Juvenile Sandbar Sharks in Delaware Bay. <[http://www.uri.edu/cels/bio/wetherbee/pubs\\_files/use%20of.pdf](http://www.uri.edu/cels/bio/wetherbee/pubs_files/use%20of.pdf)>. Downloaded 18 November 2009

## Management Documentation

**54. Identify *key management documentation* available for the**

Borg J & McAuley R (2004). Future Management Arrangements for Western Australia's Temperate Shark Fisheries. A Discussion



species, e.g. recovery plans, conservation plans, threat abatement plans.

Paper. Fisheries Management Paper No. 180. Government of Western Australia.

Brewster-Geisz KK & Miller TJ (2000). Management of the sandbar shark, *Carcharhinus plumbeus*: implications of a stage-based model. Fisheries Bulletin (98): 236-249. <<http://fishbull.noaa.gov/982/02.pdf>> Downloaded 15 Dec 2009.

DEWHA (2009a). Assessment of the Western Australian Temperate Shark Fisheries (comprising the Joint Authority Southern Demersal Gillnet and Demersal Longline Managed Fishery and the West Coast Demersal Gillnet and Demersal Longline (Interim) Managed Fishery).

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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

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