

Information for the development of Non Detriment Findings for CITES listed sharks

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Executive Summary

The implementation of CITES Appendix II listings for five shark species on September 14 2014 will require nations to develop Non Detriment Findings (NDFs) if exports are to occur. These five species of sharks – Oceanic Whitetip, Porbeagle, Scalloped Hammerhead, Great Hammerhead and Smooth Hammerhead – are significant parts, or were historically significant parts, of commercial fisheries catch in Australia or the Oceania region. As such Australia must consider if populations of these species meet the requirements for export under CITES rules. This document considers the take, stock status and potential sustainable take levels of these species relative to the production of NDFs for these species. It also considers the broader Oceania region issues in relation to the production of NDFs because of the shared nature of the stocks of these shark species and the limited capacity of many Oceania nations.

The take of the five species varies dramatically. Catches of Oceanic Whitetip and Porbeagle Sharks are currently limited, either because of fishery regulations or the lack of fisheries operating in areas where they occur. Catches of hammerhead species are larger, but often difficult to determine at species-specific levels because of identification issues. Australia likely shares stocks of all of these species with its neighbours, potentially complicating the assessment of status and development of NDFs. The possible exception to this is the smooth hammerhead for which there is genetic evidence of population structuring at small spatial scales suggesting that there is separation of Australian and New Zealand populations. There is limited information on the status of these stocks within Australian waters and also regionally at spatial scales appropriate to the consideration of individual stocks. The exception to this is the Oceanic Whitetip Shark for which a full stock assessment in the western Pacific Ocean has been completed. This assessment shows that the stock has been reduced to very low levels and has resulted in a ban in retention by nations that are members of the Western Central Pacific Fisheries Commission. There is evidence of substantial population decline in Scalloped Hammerhead Sharks in Australia, but the extent of the decline remains to be accurately quantified through stock assessment. Significant declines are also likely in Indonesia which has been shown to be part of the same genetic stock. There is little data on the status of Great Hammerhead Sharks due to identification issues with Scalloped Hammerhead Sharks. Smooth Hammerhead Sharks appear to be the species with the least concern about its stock status. Catch rate data from southwestern Australia suggest that there has not been any decline in the stock since 1990.

In terms of the production of NDFs for these shark species a range of recommendations is provided. Two species – Oceanic Whitetip and Porbeagle – are either banned from retention or are not currently permitted for export and as such the production of NDFs is unwarranted. For the hammerhead species the lack of detailed stock status data makes recommendations about the level of take allowed under an NDF difficult to determine. One possible option is to cap catches at current levels while work to quantify the status of stocks and sustainable take levels is undertaken. This option would require not only understanding the effect of Australian catches, but also those of other nations that fish the same stock. This issue is further complicated by the three hammerhead species currently being assessed for threatened species listing under the EPBC Act.

Given that Oceania nations share stocks of many of these shark species there are significant advantages to developing a regional level approach to the development of NDFs as well as the research and monitoring that underpin them. The document develops a model for the implementation of such a regional approach that would take best advantage of the limited regional resources and capabilities.

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Background

In April 2013 the Convention on International Trade in Endangered Species (CITES) Conference of the Parties (CoP) listed seven species of sharks and rays (Table 1) on Appendix II. This listing is to come into force on September 14, 2014, following an 18 month implementation period. These listings bring to 17¹ the number of shark and ray (=elasmobranch) species listed on the CITES Appendices (Table 1). Unlike the previously listed species the newly listed shark and ray species form significant components of fisheries catches globally. As such the implementation of processes associated with international trade in these species will require significant changes in how governments approve exports of these species and how the fishing industry gets approval for export. In Australian waters the five shark species are taken in varying amounts in State and Commonwealth managed fisheries (Koopman & Knuckey 2014). However, there are no data to suggest that the two newly listed manta ray species are retained in Australian fisheries or that they are caught with any frequency.

Table 1 Elasmobranch species listed on the Appendices of the CITES. Listing on Appendix I precludes normal international trade, while an Appendix II listing allows international trade provided that it is not detrimental to the survival of the population.

Common name	Scientific name	Year listed	Appendix
Oceanic whitetip shark	<i>Carcharhinus longimanus</i>	2014	II
Porbeagle shark	<i>Lamna nasus</i>	2014	II
Scalloped hammerhead shark	<i>Sphyrna lewini</i>	2014	II
Great hammerhead shark	<i>Sphyrna mokarran</i>	2014	II
Smooth hammerhead shark	<i>Sphyrna zygaena</i>	2014	II
Giant manta ray	<i>Manta birostris</i>	2014	II
Reef manta ray	<i>Manta alfredi</i>	2014	II
Freshwater sawfish	<i>Pristis microdon</i> (=P. <i>pristis</i>)	2014	I
Dwarf sawfish	<i>Pristis clavata</i>	2007	I
Common sawfish	<i>Pristis pristis</i>	2007	I
Smalltooth sawfish	<i>Pristis pectinata</i>	2007	I
Largetooth sawfish	<i>Pristis perotetti</i> (=P. <i>pristis</i>)	2007	I
Green sawfish	<i>Pristis zijsron</i>	2007	I
Narrow sawfish	<i>Anoxypristis cuspidata</i>	2007	I
White shark	<i>Carcharodon carcharias</i>	2005	II
Whale shark	<i>Rhincodon typus</i>	2003	II
Basking shark	<i>Cetorhinus maximus</i>	2003	II

¹ Recent taxonomic changes to the sawfishes means that 2 of these species are no longer valid.

Terms of Reference

- 1) An estimate of Australian population levels for the five shark species taking into account, but not limited to, the species' range, density, migration and interaction within regionally shared stocks.
- 2) Advice on sustainable catch limits for Australian fisheries that interact with the species taking into account domestic historic catch data, domestic and regional mortality rates for the five shark species, and where possible estimates of domestic and regional illegal, unreported and unregulated fishing activities. Recommend appropriate scales for NDFs for newly listed sharks.
- 3) Identify available information, and information needed, to support NDF requirements² of other State Parties in the Oceania region including, but not limited to, gaps in information on population, range, density, migration, harvest and interaction within regionally shared stocks of the five CITES listed shark species. Based on these information requirements, develop a methodology for regional data collection and stock assessment to support development of NDFs for other State Parties in the Oceania region. Include in the methodology a process for investigating the capacity for improvements in implementation of NDFs within the countries of the Oceania region. This methodology will then be used as a basis for further capacity building activities in the Oceania region.

Population levels of CITES listed sharks

Oceanic Whitetip Shark

The Oceanic Whitetip Shark, *Carcharhinus longimanus*, is a large carcharhinid shark that occurs globally in the tropical open ocean. It is frequently caught in pelagic longline fisheries where it forms a small proportion of the overall shark bycatch (Clarke et al. 2013, Tolotti et al. 2013). It grows in excess of 300 cm in length. Detailed information on the distribution, catch and life history parameters has been provided by (Koopman & Knuckey 2014) and it will not be repeated here unless required for specific purposes.

Distribution and stock structure

This species is distributed in all of the world's tropical and sub-tropical oceans (Figure 1). It rarely occurs on continental shelves, and then only at the outer edges (Stevens 1984). Pop-up satellite tracking in the western Atlantic has provided useful data on the movements of Oceanic Whitetip Sharks (Howey-Jordan et al. 2013). This study demonstrated that in the open ocean they mostly occur above 100 m, with most individuals occupying depths of 30-60 m. Despite normally occupying shallow depths individuals have been reported to regularly dive to several hundreds of metres and occasionally to near 1000 m.

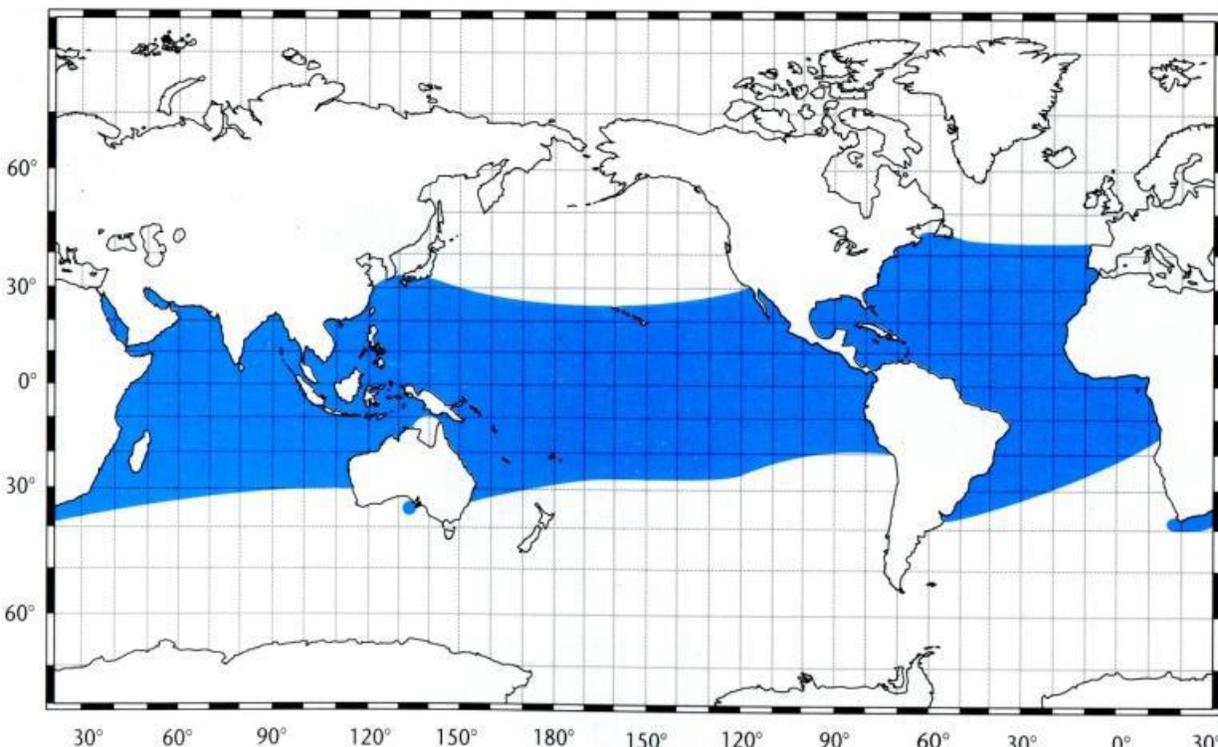


Figure 1 Distribution of the Oceanic Whitetip Shark, *Carcharhinus longimanus*. Reproduced from Last and Stevens (2009).

While information on the distribution, and to some extent movements, is available for Oceanic Whitetip Sharks there is little information on the stock structure. There have been no studies on the population genetics to identify areas that show evidence for isolated genetic signatures that would suggest stock separation (CITES 2013). Information on the movements from tagging and tracking work can also provide data on stock structure. However, the vast majority of this work has occurred in the Atlantic and so must be extrapolated to the Oceania region. Tagging results from the US cooperative Shark Tagging Project have provided a limited amount of tag-recapture data (Kohler et al. 1998) that demonstrate movements in the range of hundreds to thousands of kilometres (Figure 2). More detailed movement data are available from satellite tracking data of sharks released in the Bahamas (Howey-Jordan et al. 2013, Figure 3) and Cayman Islands (<http://www.nova.edu/ocean/ghri/tracking/>). These studies have confirmed that Oceanic Whitetip Sharks regularly move over thousands of kilometres (Figure 4), with most satellite tracked individuals moving between 1500 and 2000 km from their point of release. The satellite tracking also demonstrated a high level of philopatry, with most animals returning to the area in which they were originally released.

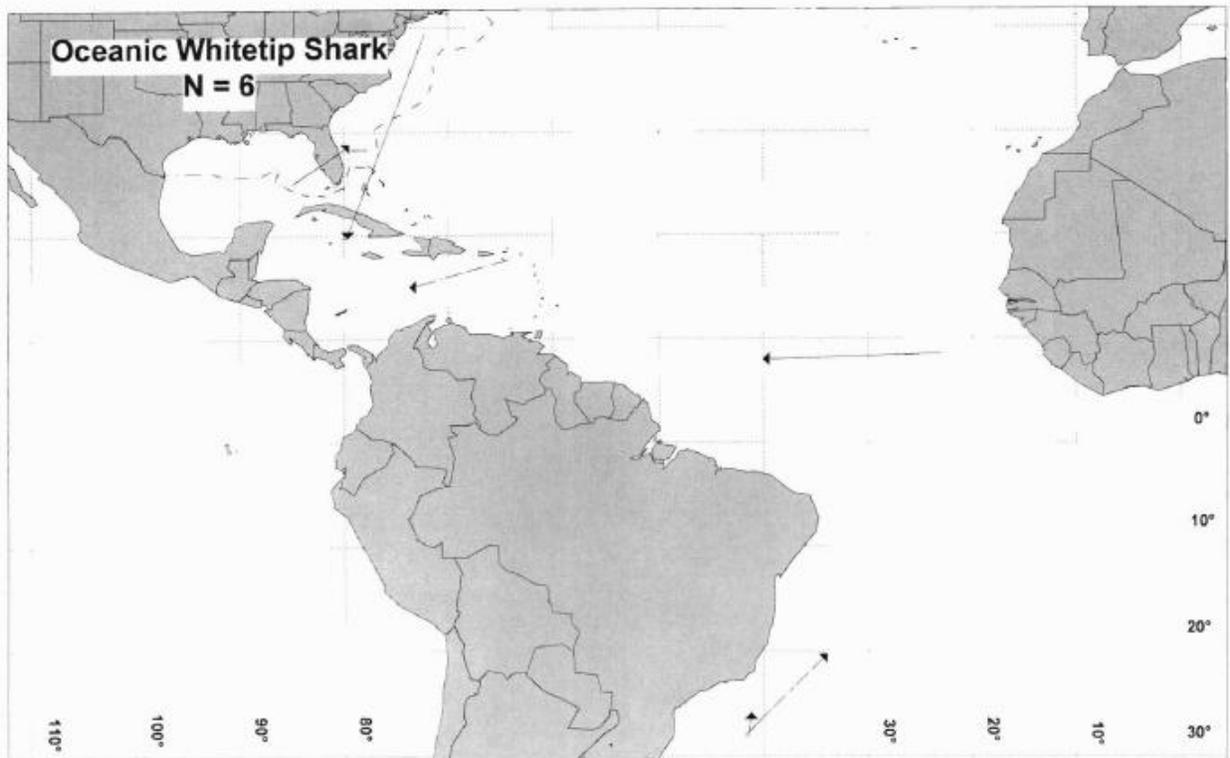


Figure 2 Movements of recaptured Oceanic Whitetip Shark from the US National Marine Fisheries Service's Cooperative Shark Tagging Program. Reproduced from Kohler et al. (1998)

The results of the western Atlantic Ocean tagging and tracking provide the best information possible on the stock structure of Oceanic Whitetip Sharks in the Oceania region. The distances travelled demonstrate that there is likely to be mixing of animals throughout the western Pacific and eastern Indian Oceans. Whether there is mixing between the Pacific and Indian Ocean animals will depend on whether they move through the Indonesian archipelago. It is possible that there will be separate stocks between eastern and western Australia, but this would need to be determined by future research. Based on the tagging and tracking work there is likely to be limited stock structure in which case

Australia will share these stocks with its regional neighbours. There is a clear need for further research on the stock structure of this species.

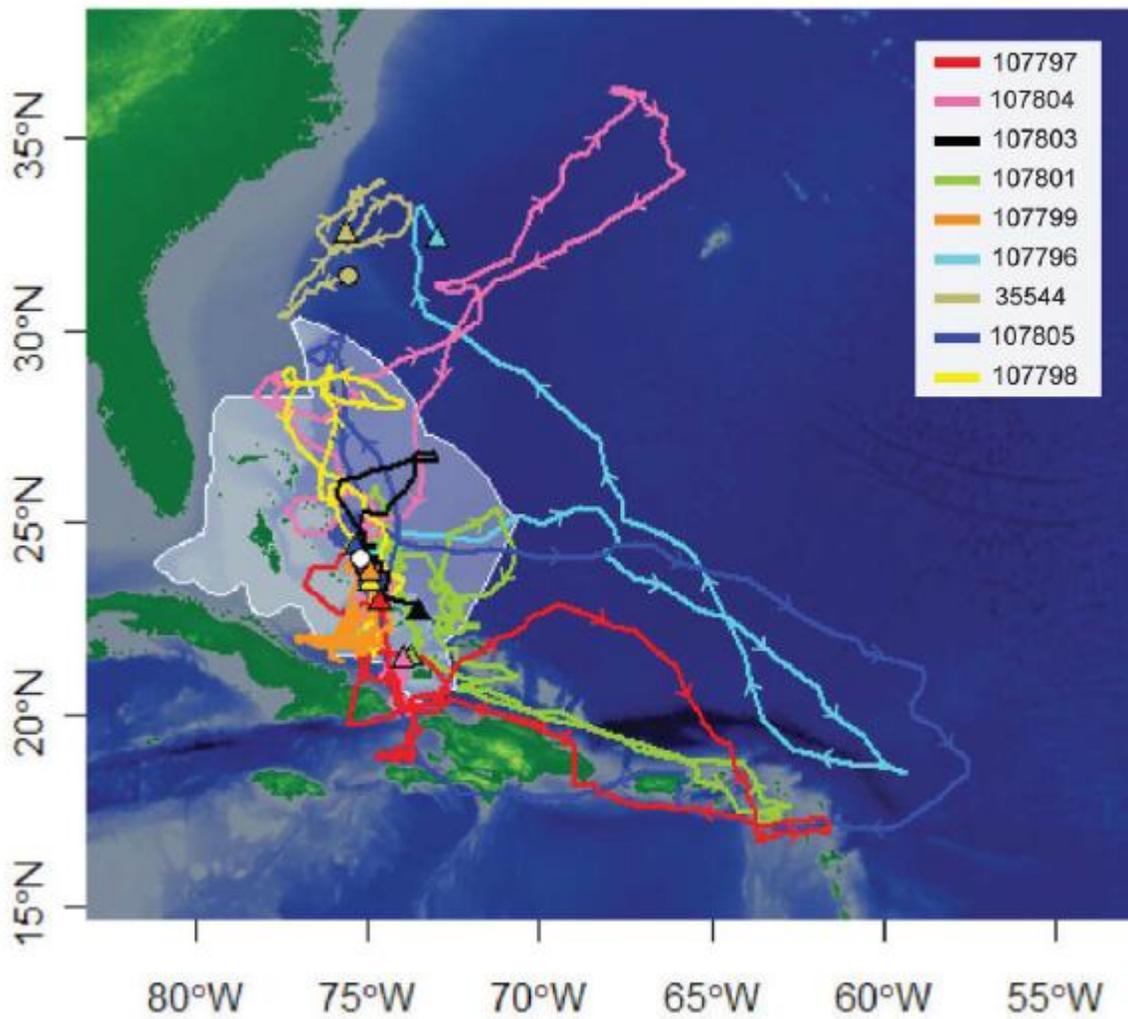


Figure 3 Tracks of Oceanic Whitetip Sharks released in the Bahamas. For geographic scale, 5 degrees of latitude or longitude is equivalent to 556 km.

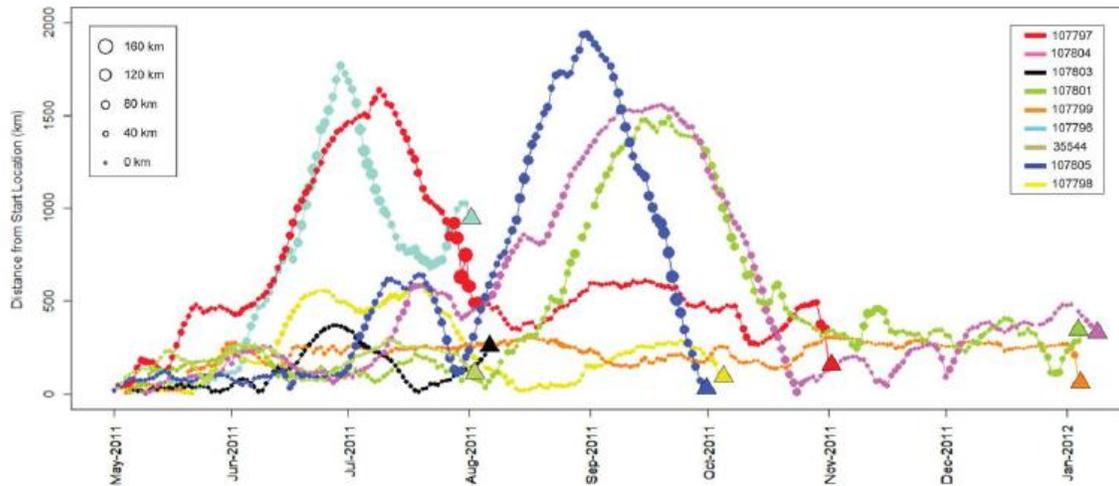


Figure 4 Distances moved by satellite tracked Oceanic Whitetip Sharks from their point of release. Reproduced from Howey-Jordan et al. (2013)

Levels of take

Koopman and Knuckey (2014) provided detailed catch data for Oceanic Whitetip Sharks in all of Australia's commercial fisheries. The largest amount of take occurs in the commonwealth managed tropical tuna fisheries (Eastern Tuna and Billfish Fishery; Western Tuna and Billfish Fishery) while small amounts are also taken in some state fisheries (e.g. Western Australian tropical shark fisheries which are currently inactive). The overall take in Australian fisheries is quite small, dropping from 15-20 t around 2000 to less than 5 t currently. These declines occurred during a period when effort in these fisheries has been decreasing and regulations to reduce shark bycatch have been implemented. There is a small amount of take in recreational fisheries (Stevens 1984, Cheshire et al. 2013). There is also a reported take in IUU fishing in Australian waters. Marshall (2011) estimated that Oceanic Whitetip Sharks make up about 5.9% (in numbers, 3.6% in biomass) of the catch by foreign IUU operations. The estimated take by Indonesian based IUU operators in 2006 was about 700 t (Marshall 2011), and has declined since that time. As such current IUU catches are probably small in Australian waters.

When considering the effect of the level of take on the status of this species catches outside of Australia must also be considered. Koopman and Knuckey (2014) provided information on the relative global importance of Australia's Oceanic Whitetip Shark take over the past decade. These figures demonstrated that Australia's take is has typically been less than 1% of the global take. However, in developing NDFs for long lived species, like many of the shark species, catches over long time periods will be required to ensure historic catches (pre 2000) did not lead to declines.

Population levels

Recent assessments of the status of Oceanic Whitetip Sharks are available from the Western Central Pacific Fisheries Commission (WCPFC) (Rice & Harley 2012) and Indian Ocean Tuna Commission (IOTC) (IOTC 2013). Given the uncertainty about the stock structure of this species, and especially whether separate stocks exist off the east and west coast of Australia, the most risk-averse strategy is to consider

them as separate stocks. The quality of the assessments is quite different. The WCPFC assessment was a full stock assessment using an age-structured model. The IOTC assessment used an ecological risk assessment approach along with an examination of catch and catch rate data.

Western and Central Pacific assessment

This assessment used a variety of data from a range of fisheries in the region, including longline fisheries from the Australian exclusive economic zone (EEZ) (Figure 5). Full details of the assessment methodology, data used, etc. are provided in the stock assessment report (Rice & Harley 2012) and will not be repeated here. The assessment concluded that the spawning (=breeding) biomass of the stock had declined by 86% over the period from 1995 to 2009 (Figure 6), and that fishing mortality was more than six times higher than would be suitable to achieve maximum sustainable yield (MSY). The assessment also noted that since the time series used in the assessment only began in 1995, and given substantial decline was likely prior to this period, that the population decline relative to pre-exploitation levels is even greater than the 86% reported. The model estimated the current biomass level is between 3 and 19% of pre-exploitation levels, and mostly likely around 7%. The assessment did not provide data on the estimated number of individuals in the population, but did provide a best estimate of total biomass at 8,672 t (down from ~110,000 t). On the basis of the assessment results Rice and Harley (2012) concluded that the stock was overfished (i.e. biomass less than that which would produce MSY) and overfishing was still occurring (i.e. fishing mortality was higher than that which would produce MSY). On the basis of this stock assessment report the WCPFC adopted a resolution to prohibit the landing of Oceanic Whitetip Sharks in 2012.

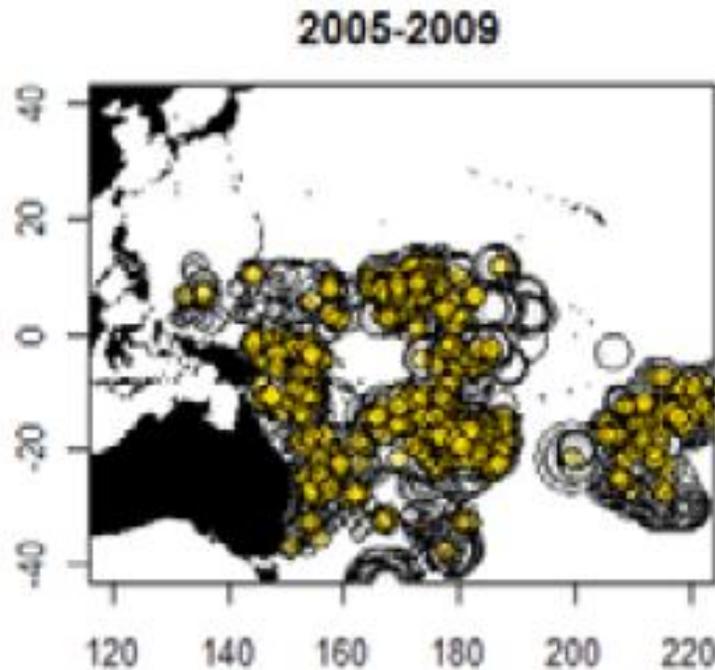


Figure 5 Catch and effort data 2005-2009, including that from Australia, used in the WCPFC stock assessment of Oceanic Whitetip Sharks. Open circles indicate effort, yellow circles indicate catches.

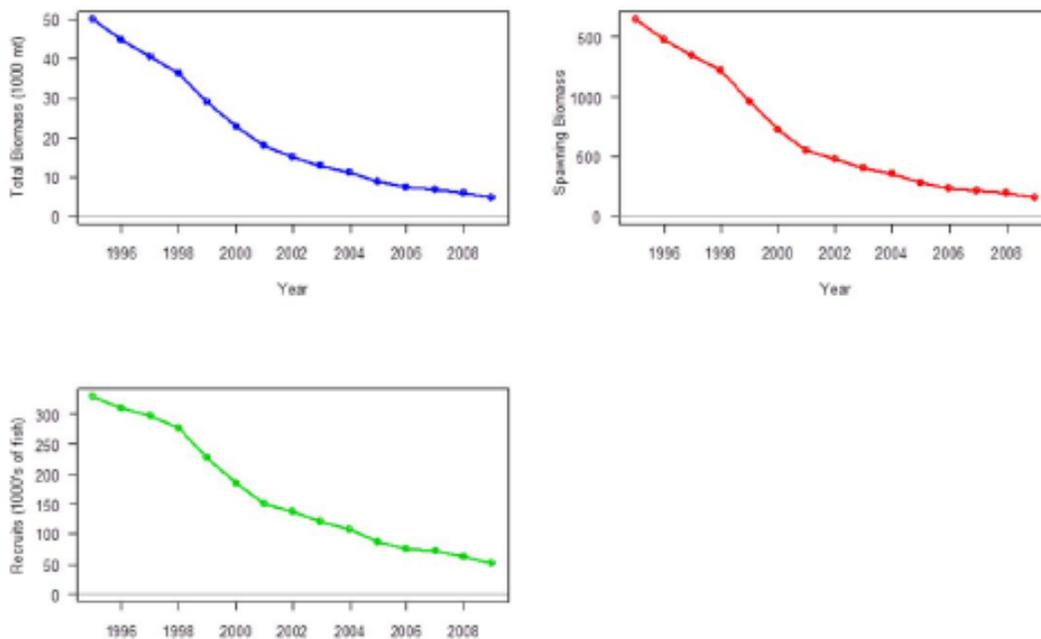


Figure 6 Modelled trends in the total biomass (blue), spawning (=breeding) biomass (red) and numbers of recruits (green) of Oceanic Whitetip Sharks in the western and central Pacific Ocean. Reproduced from Rice and Harley (2012)

Indian Ocean assessment

This assessment used available data from the Indian Ocean, including an Ecological Risk Assessment that identified this species as at high risk, anecdotal information that suggested that abundance had declined over several decades and the species was now rare, and recent catch rate data (IOTC 2013). The report concluded that there was insufficient information to determine the status of the population in the Indian Ocean based on the available data. However, given the declines in abundance reported in other ocean basins (e.g. Baum & Worm 2009, Rice & Harley 2012), and the level of fishing effort in the Indian Ocean, it is likely that the population has declined substantially from pre-exploitation levels. While the exact status in the Indian Ocean could not be determined IOTC adopted a resolution to ban the landing of Oceanic Whitetip Sharks in 2013 because of concerns for this species.

Porbeagle Shark

The Porbeagle Shark is a medium sized lamnid shark that has an amphitemperate distribution in most of the world's oceans. It grows to a maximum length of around 350 cm (Last & Stevens 2009). Like most lamnid sharks it has the ability to elevate its body temperature above ambient water temperature. It is a long-lived and slow growing species that produces litters of 1-5 young (Francis et al. 2008).

Distribution and stock structure

The Porbeagle Shark has two distinct parts to its distribution – the temperate North Atlantic and the Southern Ocean (Figure 7) where it lives along continental margins and in the open ocean. In the

northern Pacific Ocean this species is replaced by the closely related Salmon Shark (*Lamna ditropis*). One of the main drivers of the distribution of this species is water temperature, with the species having relatively narrow thermal preferences (Francis et al. 2008). The North Atlantic population has been well studied as it has been a fishery target for several decades by both North American and European fishers (Campana et al. 2002). The Southern Ocean population is less well studied, but scientists in New Zealand have conducted research and monitoring on this species.

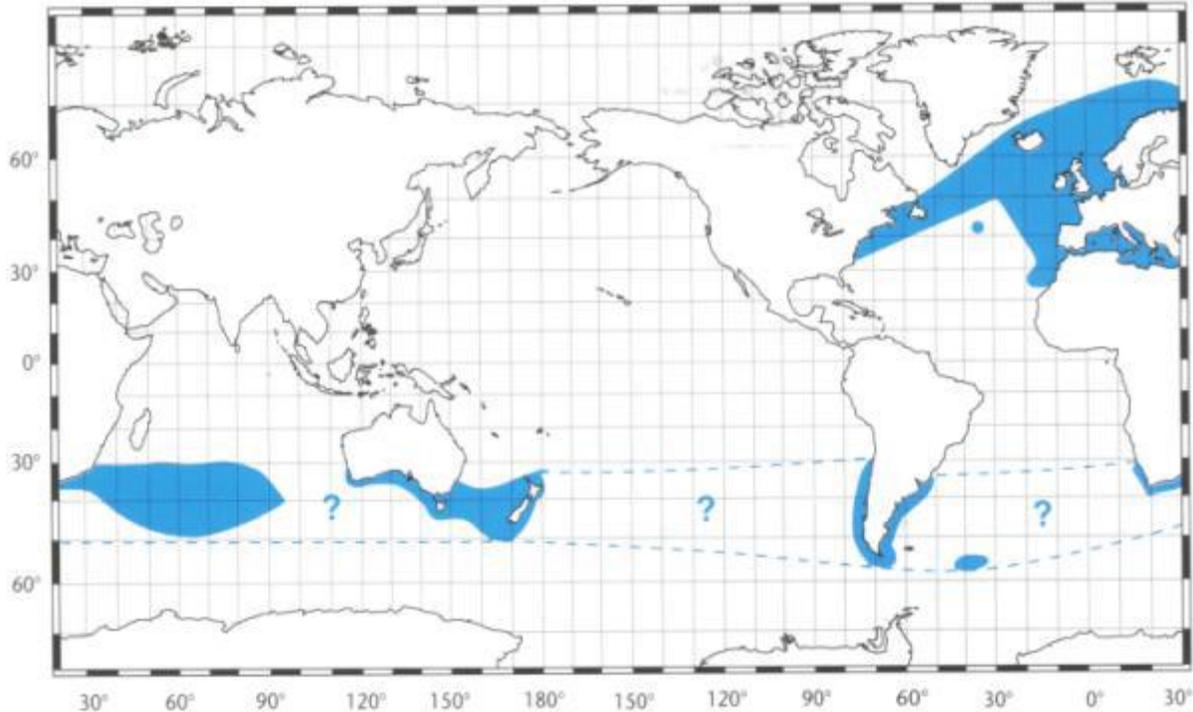


Figure 7 Distribution of the Porbeagle. Reproduced from Last and Stevens (2009).

A recent population genetics study (Testerman 2014) demonstrated clear differences in the stock between the northern and southern hemisphere. This same study examined genetic material from five locations in the southern hemisphere (Falkland Islands, Chile, South Africa, Tasmania and New Zealand) and found no evidence of population structuring. These data suggest that there is a single stock in the southern hemisphere.

The genetic data suggesting a single southern hemisphere stock is supported by tag-recapture data from the western north Atlantic that shows individuals move relatively long distances along continental margins, but rarely venture long distances across the open ocean (Figure 8). However, pop-up satellite tagging has shown that adult Porbeagle Sharks leave continental margins and travel large distances across the open ocean to give birth in more tropical waters (FAO Species Catalogue for Fishery Purposes. Campana et al. 2010) (Figure 9). On the basis of his research, it has been suggested that in the North Atlantic there are two stocks – a western stock off North America and an eastern stock off Europe (Francis et al. 2008). This conclusion, however, is not supported by the genetic results of Testerman (2014). In the Southern Ocean Francis et al. (2008) concluded based on the data from the North Atlantic that several stocks could exist. However, this conclusion was made prior to the availability of the genetic and satellite tagging results that support a single stock conclusion.

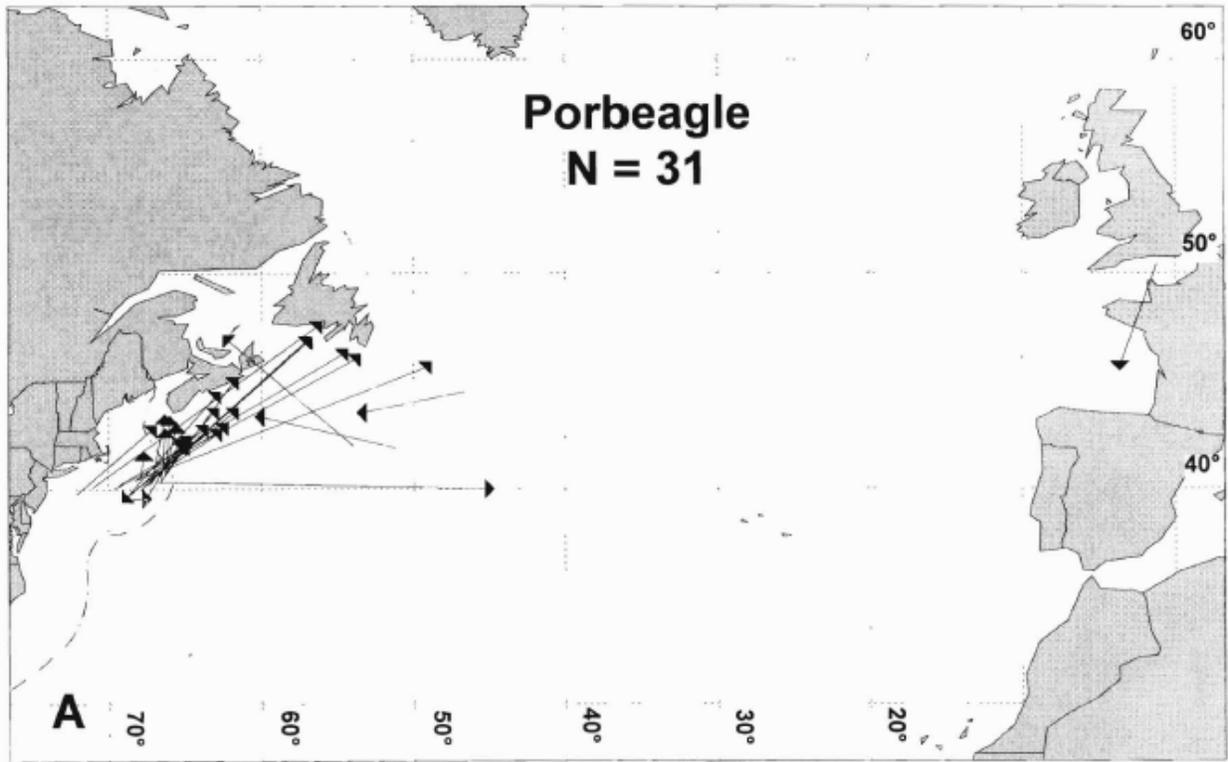


Figure 8 Tag-recapture data for Porbeagle Sharks released as part of the US Cooperative Shark Tagging Program. Reproduced from Kohler et al. (1998)

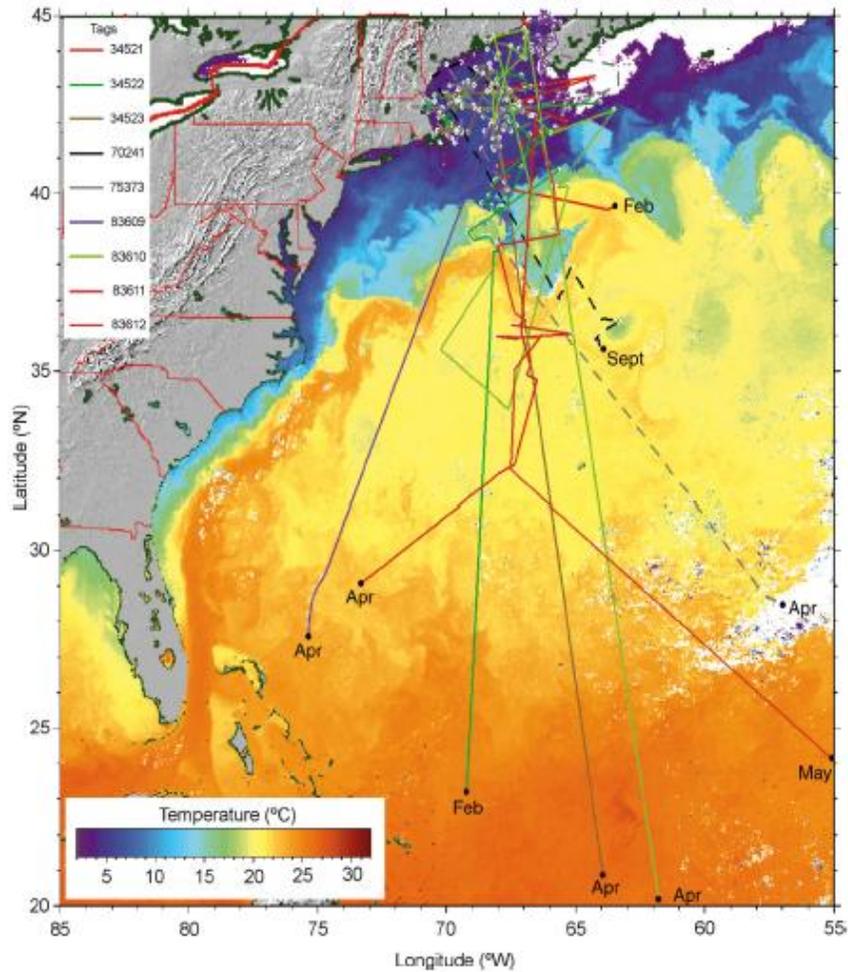


Figure 9 Movements of pup satellite tagged Porbeagle Sharks in the western North Atlantic. Reproduced from Campana et al. (2010).

Levels of take

Porbeagle Sharks are rarely taken in Australian fisheries. The main catch is in the Commonwealth managed Eastern Tuna and Billfish Fishery (EBTF) and Gillnet, Hook and Trap (GHAT) sector of the Commonwealth managed Southern and Eastern Scalefish and Shark Fishery (SESSF). Annual catches in the EBTF have been less than 1 t for the past 10 years, while those in the GHAT have been <1 t. There is minimal take of Porbeagle Sharks by recreational fishers (Cheshire et al. 2013).

When considering the effect of the level of take on the status of this species catches outside of Australia must also be considered. Koopman and Knuckey (2014) provided information on the relative global importance of Australia's Porbeagle Shark take over the past decade. These figures demonstrated that Australia's take is has typically been much less than 1% of the global take. However, in developing NDFs for long lived species, like many of the shark species, catches over long time periods will be required to ensure historic catches (pre 2000) did not lead to declines.

Population levels

There is currently no stock assessment available for Porbeagle Sharks in the Southern Ocean. However, New Zealand was leading a Commission for the Conservation of Southern Bluefin Tuna (CCSBT) initiative to assess the status of the stock(s) during 2013/2014. However, this work appears to have stalled because of data limitations. Without progress on this stock assessment an improved understanding of the sustainable levels of take from this species are unlikely.

Scalloped Hammerhead Shark

The Scalloped Hammerhead Shark is probably the most common and well known species of hammerhead. It occurs in tropical and subtropical oceans worldwide. It reaches sizes of over 4 m in length, grows slowly and produces large litters of young (Harry et al. 2011a). It is the only hammerhead known to form predictable aggregations, normally associated with sea mounts.

Distribution and stock structure

Scalloped Hammerhead Sharks occur in tropical and subtropical waters of all of the world's oceans (Figure 10). It is commonly found in continental shelf waters, but also regularly enters estuaries and open ocean environments. Significant catches of this species in pelagic longline fisheries (e.g. Beerkircher et al. 2002) suggests it spends more time in open ocean areas compared to the other species of hammerheads. There appears to be ontogenetic change in distribution, with the young living in coastal nursery areas (e.g. Clarke 1971, Simpfendorfer & Milward 1993, Duncan & Holland 2006) and then moving offshore as they grow (Harry 2011). Populations also demonstrate high levels of sexual segregation. For example, in Australian waters there are few records of pregnant females (Stevens & Lyle 1989, Noriega et al. 2011) while in Indonesia pregnant females are commonly reported (White et al. 2008). Observations from the Queensland coast also suggest that males remain in inshore areas longer than do females (Harry 2011).

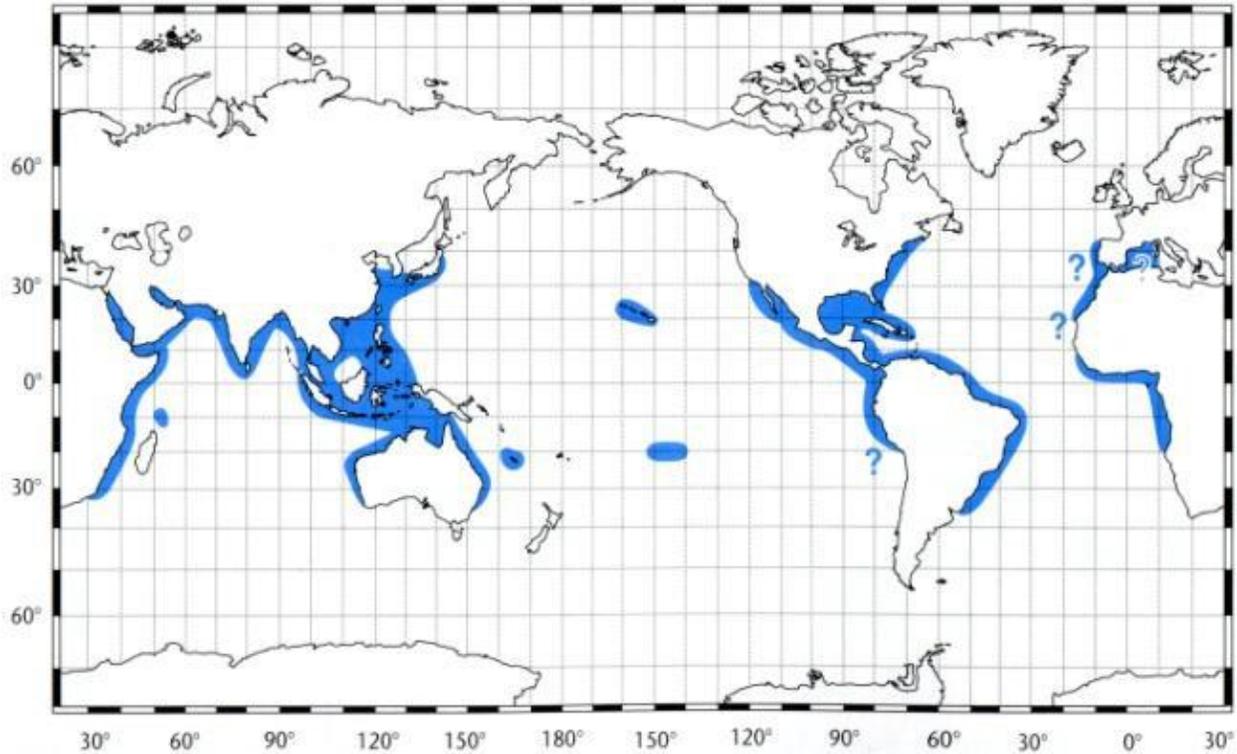


Figure 10 Distribution of the Scalloped Hammerhead Shark. Reproduced from Last and Stevens (2009)

The population genetics of Scalloped Hammerhead Sharks have been well studied, both globally and in Australian waters. The global pattern of stock structure varies between females and males, reflecting the strong sexual segregation. Duncan et al. (2006) found that female genetic markers showed little evidence for movements of females at more than regional scales and that they rarely cross open ocean areas. They also concluded that there was little evidence for female stock structure along continuous continental shelf areas. In contrast Daly-Engel et al. (2012) using nuclear markers that are not sex biased found little evidence for stock structure within ocean basins and little evidence for differences between ocean basins. These results point to complex stock structure within this species. Within the Oceania region Ovenden et al. (2009) found no evidence for separate stocks between northern Australia and Indonesia, or within Australian waters. Detailed investigation of Scalloped Hammerhead Sharks occurring on the east coast of Queensland also found no evidence of stock structure, or differences with Indonesia (Ovenden et al. 2011).

There are limited published tagging and tracking results available for Scalloped Hammerhead Sharks in Australian waters. Telemetry research is currently being undertaken on the Queensland east coast using both acoustic and satellite telemetry (M Heupel pers. comm.). Tagging has been carried out in various parts of northern Australia, but recaptures are limited and little useful data are currently available. Data from other regions, such as the east coast of the USA, demonstrates that this species regularly moves on the scale of hundreds to thousands of kilometres (Figure 11). Shorter movements were recorded in research in South Africa, with individual only being recaptured over distances of <150 km (Diemer et al. 2011). The study of this species in the eastern Pacific where they occur at a range of small oceanic islands has demonstrated that larger individuals regularly move between islands within island groups (e.g. Galapagos Islands) and at times between distantly spaced islands (Hearn et al. 2010, Ketchum et al. 2014a, Ketchum et al. 2014b).

The results of genetic, tagging and telemetry studies provide consistent evidence that Scalloped Hammerhead Sharks move widely, including through open ocean habitats. The longer movements appear to be taken by males, which show little evidence for stock structure at the ocean basin scale. Females, however, show some evidence for natal philopatry that provides some evidence for stock structure. There is direct genetic evidence that Australia shares a stock with Indonesia, and the movement ability demonstrated for tagging and telemetry studies suggests quite strongly that this stock may also be shared with other island nations in the western Pacific. These results will have significant implications for the status of Scalloped Hammerheads in Australian waters and the estimation of sustainable levels of take for NDFs in the Oceania region. However, further work to test these hypotheses of a single regional stock, and the rate of exchange between nations in the Oceania region, will be essential to allow more detailed assessment and hence NDFs.

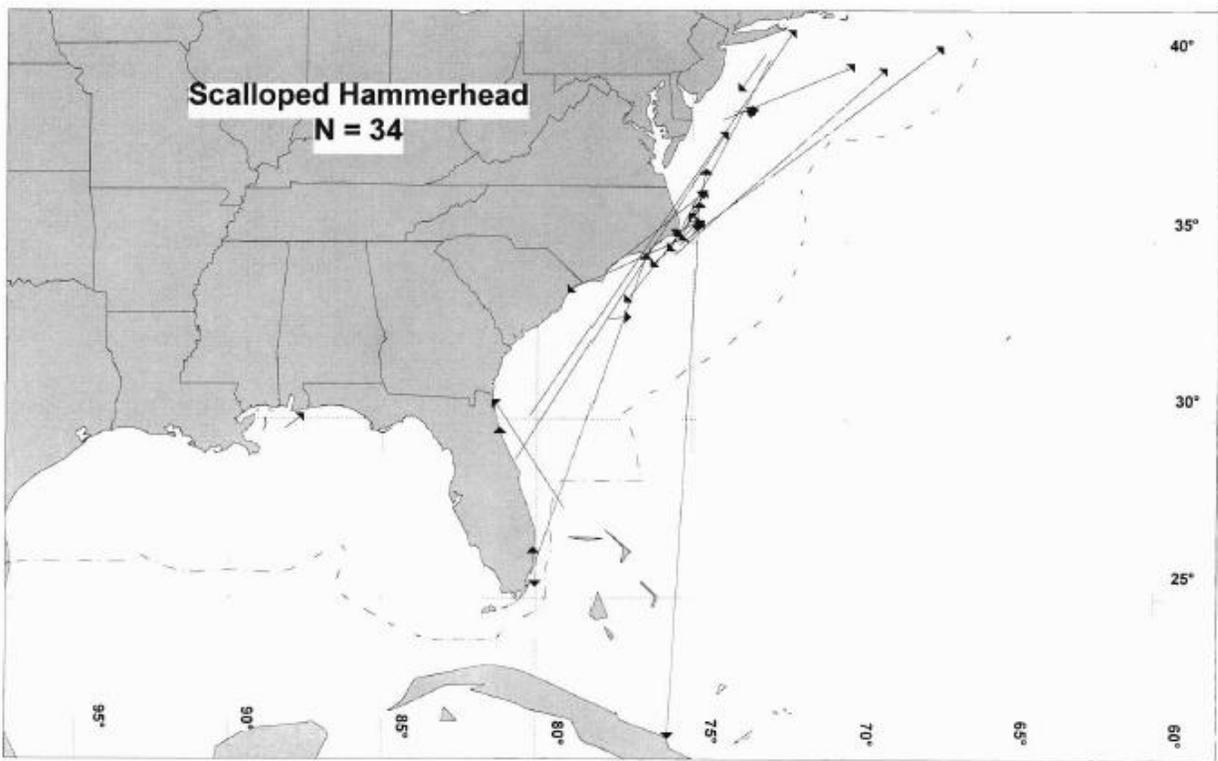


Figure 11 Movements of Scalloped Hammerhead Sharks tagged by the US Cooperative Shark Tagging Program. Reproduced from Kohler et al. (1998)

Levels of take

Scalloped hammerheads are taken in a variety of fisheries in northern Australia. The principal ones are the fisheries that target shark, especially the New South Wales Ocean Trap and Line Fishery (OTLF), Queensland East Coast Inshore Finfish Fishery (ECIFF), Queensland Gulf of Carpentaria Inshore Finfish Fishery (GCIFF), Northern Territory Offshore Net and Line Fishery (ONLF), Western Australian Joint Authority Northern Shark Fishery (JANSF) and Western Australian North Coast Shark Fishery (WANCSF). The last two of these have been mostly closed or unfished for 5-8 years, and neither currently has a Wildlife Trade Operation approval for export of products. The Queensland ECIFF has one of the largest

catches of Scalloped Hammerhead Sharks, which in some years has reported over 100 t landed, but in most years recently this is less than 80 t. The ONLF in the Northern Territory also has a large take of Scalloped Hammerhead Sharks. In 2011 this fishery took 141 t of hammerhead shark. However, species specific catches are not available and so the exact take of each species is unknown. Several other fisheries probably have annual catches in the 2-10 t range, including Queensland GCIFF, the NSW ITLF and the Commonwealth managed Eastern Tuna and Billfish Fishery (EBTF) over the last ten years. All up annual commercial catches in Australia are likely to be in the order of 200 - 250 t. It should be noted that Western Australia has been exploring the possibility of reopening its closed tropical shark fisheries. Depending on the level of effort if this occurs catches of hammerheads could add up to another 100 t to the national take. Sharks have been reported from the seized catches of foreign IUU vessels in northern Australia, but make up less than 2% of the catch by weight (Marshall 2011).

Scalloped hammerheads are taken in recreational fisheries, but data at the species level is scarce because of the difficulties in identification. De Faria (2012) showed through surveys of recreational fishers in north Queensland that Scalloped Hammerhead Sharks make up almost 7% of the catch in numbers. Cheshire et al. (2013) reported that scalloped hammerheads are regularly taken by recreational anglers and are a valued catch.

The Queensland Shark Control Program takes some Scalloped Hammerhead Sharks each year. In 2013 16 individuals up to 3.2 m in length were recorded. Hammerheads, including Scalloped Hammerheads, are the most common group taken in the New South Wales Shark Meshing Program (Reid et al. 2011). Between 1990 and 2010 1331 hammerhead sharks were captured. However, the exact species composition of the catch is unknown as individual species are not recorded. Scalloped Hammerhead

When considering the effect of the level of take on the status of this species catches outside of Australia must also be considered. Koopman and Knuckey (2014) provided information on the relative global importance of Australia's Scalloped Hammerhead Shark take over the past decade. These figures demonstrated that Australia's take is has been between 3 and 10% of the reported global take. However, in developing NDFs for long lived species, like many of the shark species, catches over long time periods will be required to ensure historic catches (pre 2000) did not lead to declines.

This species is currently being assessed for listing under the EPBC Act. Depending on if this species is listed, and the level at which it is listed, catches may be affected. The draft Conservation Advice for this species (<http://www.environment.gov.au/biodiversity/threatened/nominations/comment/scalloped-hammerhead>) indicates that it has been assessed as Endangered.

Population levels

No stock assessments are available for Scalloped Hammerhead Sharks in Australian waters or any of its regional neighbours. Given that the stock structure information available indicates that individuals occurring in Australian waters are part of a larger regional stock, any assessment will need to take into account removals in all jurisdictions and the rates of movement between them. This would be a complex undertaking. Despite the lack of a stock assessment there is some information available on trends in stock abundance from catch rate data from fisheries and shark control programs. Simpfendorfer et al. (2011) has produced the longest data set, analysing catch and effort from the QSCP from northern Queensland (Townsville and Cairns) from 1965. This analysis showed that based on standardized catch rates the population had declined to between 16.5% and 33.4% of its original levels (Figure 12). This

analysis grouped all catches of hammerhead together because during the first few decades the catch was only recorded at the group level. However, the authors concluded that most of the take was scalloped hammerheads based on size and latter species level identifications. The mean size of hammerheads taken in the QSCP, however, rose slowly over the life of the program (Figure 13), providing a contrasting result to the catch rate data. There are several possible explanations for this mismatch in the results of the program, including the migratory patterns of hammerheads and the gear selectivity of the nets used (since they were the main gear that caught hammerheads). Like Simpfendorfer et al. (2011), Heupel and McAuley (2007) reported that unstandardized catch rates of hammerheads in the WANCSF and JANSF had declined to between 24% and 42% of their original levels over a period of about 5 years. Again, these catches were not identified to species level, but it is assumed that both Scalloped and Great Hammerheads made up substantial components. Both of these results demonstrate that hammerheads can be affected quite rapidly by fishing and that populations in Australia are well below their pre-exploitation levels. The draft Conservation Advice for Scalloped Hammerhead Sharks prepared by the Department of the Environment for consideration of EPBC listing has suggested it meets the criteria for Endangered (see above), meaning a population decline of >70% over the last 10 years or three generations. The ongoing catch of hammerheads in the ECIFF, the recently stable catches rates in the QSCP and the lack of a decline in the mean annual size of animals taken in the QSCP do demonstrate that recent trends in the population may be relatively stable. However, the lack of more detailed stock assessments means that it cannot be determined if these levels are above or below sustainable take levels.

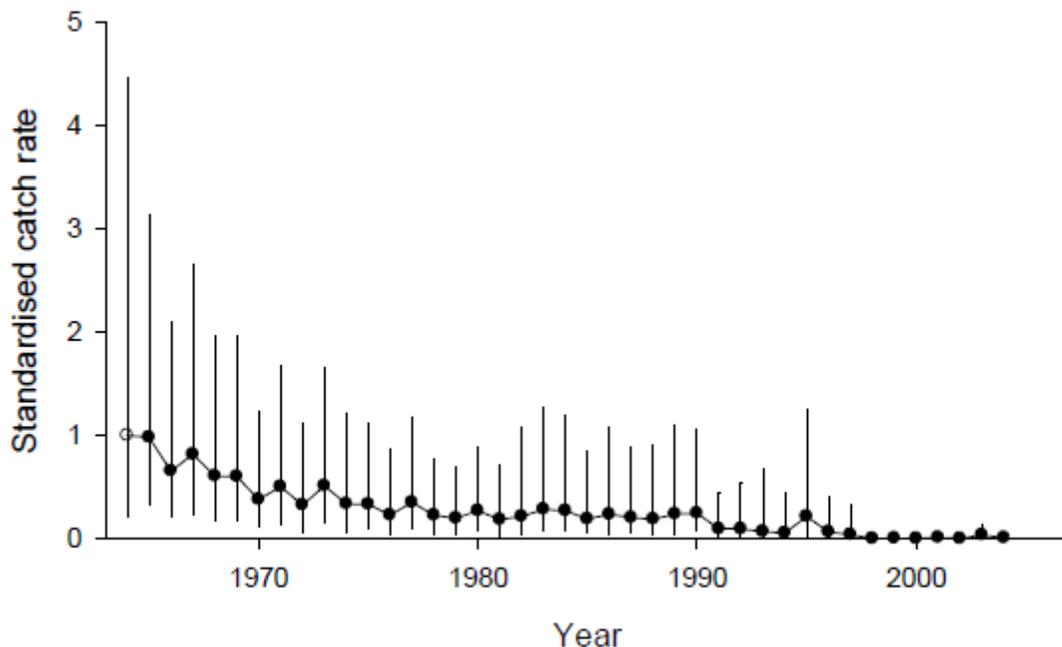


Figure 12 Standardised catch rates of hammerhead sharks from the Cairns and Townsville installations of the Queensland Shark Control Program. Data from after 1990 are not directly comparable to that prior to this date because of significant changes in the gear used in the fishery (i.e. the switch from nets to drumlines). Reproduced from Simpfendorfer et al. (2011)

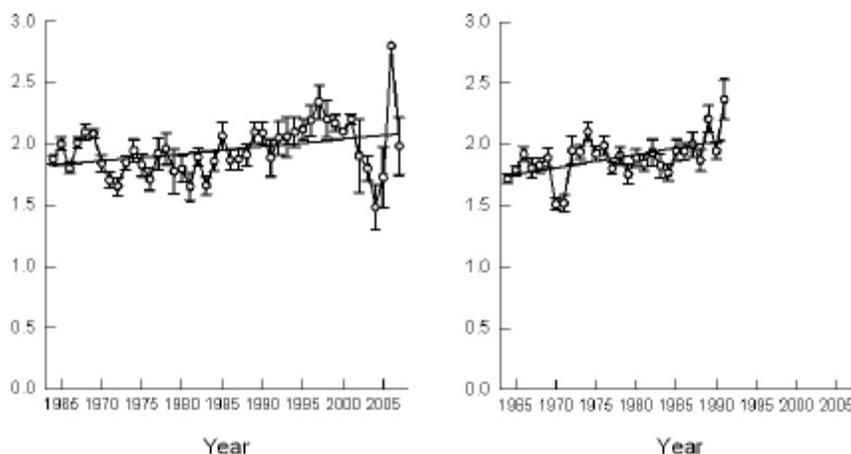


Figure 13 Mean annual size of hammerhead sharks taken in the Queensland Shark Control Program by drumlines (left) and gillnet (right). Reproduced from Simpfendorfer et al. (2011)

Although only limited stock structure data were available there is a high likelihood, based on the available movement data, that the Scalloped Hammerhead Shark population in Australia is part of the same stock as occurs in other Oceania nations. As such fishing in those countries may also have some effect on the status of the stock and would need to be considered in any assessment. The magnitude of this effect would depend on the rate of exchange between these nations, which at present is unknown. Given that Indonesia has the largest global landings of sharks (~100,000 t annually) (Blaber et al. 2009) and take significant amounts of hammerhead sharks (White et al. 2008), if there are significant levels of exchange then some of the decline observed in Australian stocks would be the result of fishing in that nation.

Great Hammerhead Shark

The Great Hammerhead Shark is the largest of the hammerheads, and one of the largest species of sharks (Last & Stevens 2009). It occurs globally in coastal and shelf waters, and occasionally has been reported from the open ocean. It is regularly taken in fisheries, but is rarely targeted and typically forms a small proportion of overall catches. It is reported to grow to over 6 m and is characterised by slow growth and large litter sizes (>30) (Harry et al. 2011a).

Distribution and stock structure

Great Hammerhead Sharks occur in tropical and subtropical sections of all of the world's oceans (Figure 14). They normally occur on the continental shelf, and rarely enter estuaries. They do enter open ocean areas, as is evidenced by their occurrence at islands in the Pacific (Figure 14) and occasional catch in pelagic longline fisheries (Beerkircher et al. 2002). There are limited published data available on the movement of this species from tagging (Kohler et al. 1998) and tracking studies (e.g. Hammerschlag et al. 2011), but there is some significant information available online (e.g. <http://rjd.miami.edu/education/virtual-learning/tracking-sharks>). These results demonstrate that this species spends significant amounts of time in coastal habitats with occasional long distance movements along coast lines or into open ocean areas.

Global scale phylogeography has been examined using genetic techniques (Testerman 2014). This analysis has shown that there are significant differences in stock between the Atlantic and Indo-Pacific

ocean basins. Specific comparison between samples from eastern and western Australia showed no evidence of stock structuring. The scale of movements indicated from satellite tagging suggests that it is likely that the population in northern Australia is connected to other countries within the Oceania region. The genetic data suggest limited stock differences between Australian and south Asia. No samples were analysed from the Pacific island nations to test for stock structuring. Further work to resolve the stock structure of this species within the region is required to define the management and assessment units. However, on the basis of available information the assumption of a single genetic stock seems the most parsimonious.

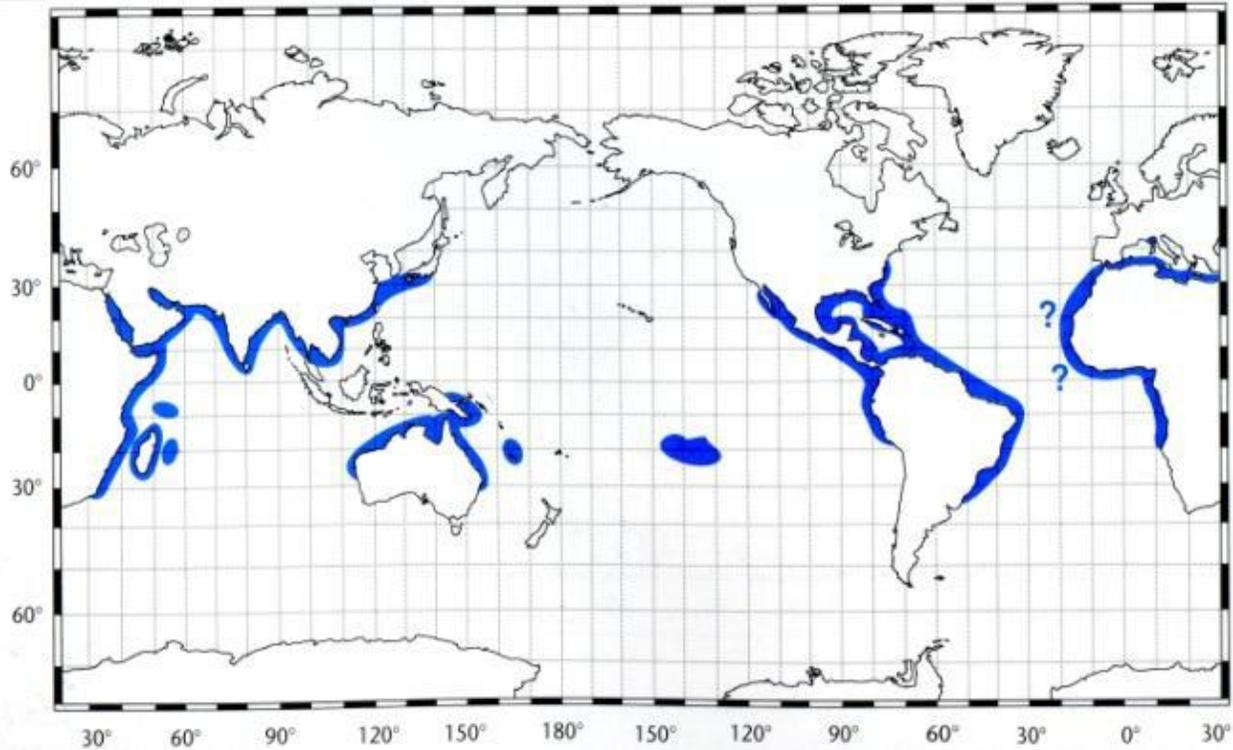


Figure 14 Distribution of the Great Hammerhead Shark. Reproduced from Last and Stevens (2009)

Levels of take

Koopman and Knuckey (2014) provided detailed catch data for Great Hammerhead Sharks in all of Australia's commercial fisheries. The largest amount of take occurs in the fisheries that take sharks across the northern half of Australia. This includes the New South Wales Ocean Trap and Line Fishery (OTLF), Queensland East Coast Inshore Finfish Fishery (ECIFF), Queensland Gulf of Carpentaria Inshore Finfish Fishery (GCIFF), Northern Territory Offshore Net and Line Fishery (ONLF), Western Australian Joint Authority Northern Shark Fishery (JANSF) and Western Australian North Coast Shark Fishery (WANCSF). Observer work has also demonstrated that minor catches are taken in other commercial fisheries but these are always reported in landings statistics (e.g. Heupel & McAuley 2007). The exact take of Great Hammerheads in these fisheries is difficult to determine because catches of all hammerhead species are often reported as a single group (Koopman & Knuckey 2014). Where observer data are available Great Hammerhead Shark catches are a significant part of the hammerhead catch. For example, in the ECIFF Harry et al. (2011b) reported that although numerically Scalloped Hammerhead Sharks were more commonly caught the larger size of Great Hammerhead Shark meant that the landed

weights were similar. The ONLF in the Northern Territory probably also has a large take of Great Hammerhead Sharks. In 2011 this fishery took 141 t of hammerhead shark. However, species specific catches are not available and so the exact take of each hammerhead species is unknown. Thus based on the available information the current annual take of Great Hammerhead Sharks is likely to be in the order of 100-150 t. However, this does not include catch in the two shark fisheries in northern Western Australia (JANSF and WANCSF) which are currently not operating. Data from when these fisheries were operating showed catches of hammerhead shark in some years exceeded 100 t, of which Great Hammerhead Sharks may make up to half. Although these fisheries are currently closed, there is consideration being given to allowing them to reopen.

Great Hammerhead Sharks are also taken in recreational fisheries in Australia, but identification issues and aggregation of taxa in recreational fishing surveys, makes estimating the level impossible and they have not been identified in a recent review of data (Cheshire et al. 2013). There is a level of take in the Queensland Shark Control Program (QSCP), which in 2013 caught 26 individuals up to 3.55 m in length. Hammerheads, including Great Hammerheads, are the most common group taken in the New South Wales Shark Meshing Program (NSW SMP) (Reid et al. 2011). Between 1990 and 2010 1331 hammerhead sharks were captured. However, the exact species composition of the catch is unknown as individual species are not recorded. While the catch from the QSCP and NSW MSP is not exported their removals does have an impact on the sustainability. Limited data on IUU fishing in northern Australia suggests that this species is taken, but that the catch made up less than 1% of the estimated 700 t take in 2006 (Marshall 2011).

Population levels

There have been no assessments of the status of Great Hammerhead Sharks in Australian waters, or those of other nations in the Oceania region. This is further confounded by the aggregation of catch data for all hammerhead species, which makes species level assessment difficult. Some information on trends in populations of aggregated hammerheads is available. Simpfendorfer et al. (2011) examined the trend in hammerhead catches in the Queensland Shark Control Program in northern Queensland and concluded based on standardized catch rates that the population had declined to between 16.5% and 33.4% of their original levels. However, the authors concluded based on size of the animals and some species level reporting that the catch was dominated by Scalloped Hammerhead Shark. Similarly, Heupel and McAuley (2007) reported that unstandardized catch rates of hammerheads in the WANCSF and JANSF had declined to between 24% and 42% of their original levels over a period of about 5 years. Both of these results demonstrate that hammerheads can be affected quite rapidly by fishing and that populations in Australia are well below their pre-exploitation levels. However, the lack of more detailed stock assessments mean that it cannot be determined if these levels are above or below sustainable take levels.

Although only limited stock structure data were available there is a high likelihood, based on the available movement data, that the Great Hammerhead Shark population in Australia is part of the same stock as occurs in other Oceania nations. As such fishing in those countries may also have some effect on the status of the stock and would need to be considered in any assessment. The magnitude of this effect would depend on the rate of exchange between these nations, which at present is unknown. Given that Indonesia has the largest global landings of sharks (~100,000 t annually) (Blaber et al. 2009) and take significant amounts of hammerhead sharks (White et al. 2008), if there are significant levels of exchange then some of the decline observed in Australian stocks would be the result of fishing in that nation.

Smooth Hammerhead Shark

The Smooth Hammerhead Shark is a moderate sized hammerhead that occurs in all of the world's subtropical and temperate oceans. In Australian waters it grows to around 350-400 cm (Last & Stevens 2009). Its anti-tropical distribution makes it unusual within the hammerheads, and means that it is often taken in different fisheries to its close relatives. Age and growth data indicate that like other similar sized hammerhead species the Smooth Hammerhead shark grows relatively slowly (Coelho et al. 2011). Like other hammerheads it has relatively large litter sizes, with the mean reported being over 30 (Compagno 1984).

Distribution and stock structure

Smooth Hammerhead Sharks occur in subtropical and temperate seas, and in Australia they occur in the southern half of the country (Figure 15). In Australian waters it occurs from Brisbane, Queensland, south and west to Geraldton, Western Australia, where they normally occur in continental shelf waters. They rarely enter estuaries, and have occasionally been reported from open ocean areas as bycatch in pelagic longline fisheries (Beerkircher et al. 2002). The more temperate distribution of this species means that there is only limited overlap with the other hammerhead species that occur in Australian waters.

Genetic investigation of global phylogeography has been undertaken (Testerman 2014). This analysis included data from Australian waters and demonstrated a significant difference between Atlantic and Indo-Pacific Ocean basins. The study also showed that within ocean basins there was evidence of population structuring. Specific comparisons between eastern and western Australia were not available. There was some comparison between eastern Australia and New Zealand, with mitochondrial DNA suggesting separation, but nuclear DNA showing no difference. Further data on the stock structure can be inferred from the limited tag-recapture data available, such as those from the US Cooperative Shark Tagging Program (Figure 16) which show movements restricted to the continental shelf. The distances moved were mostly relatively short, but some movements >1000 km do occur. Similar data are available from South Africa (Diemer et al. 2011), where the maximum movement recorded was 348 km. These tagging data that show limited dispersal support the within ocean basin population structuring suggested by the mitochondrial DNA. On the basis of these data the management of Australian Smooth Hammerhead Sharks as a single isolated stock is supported.

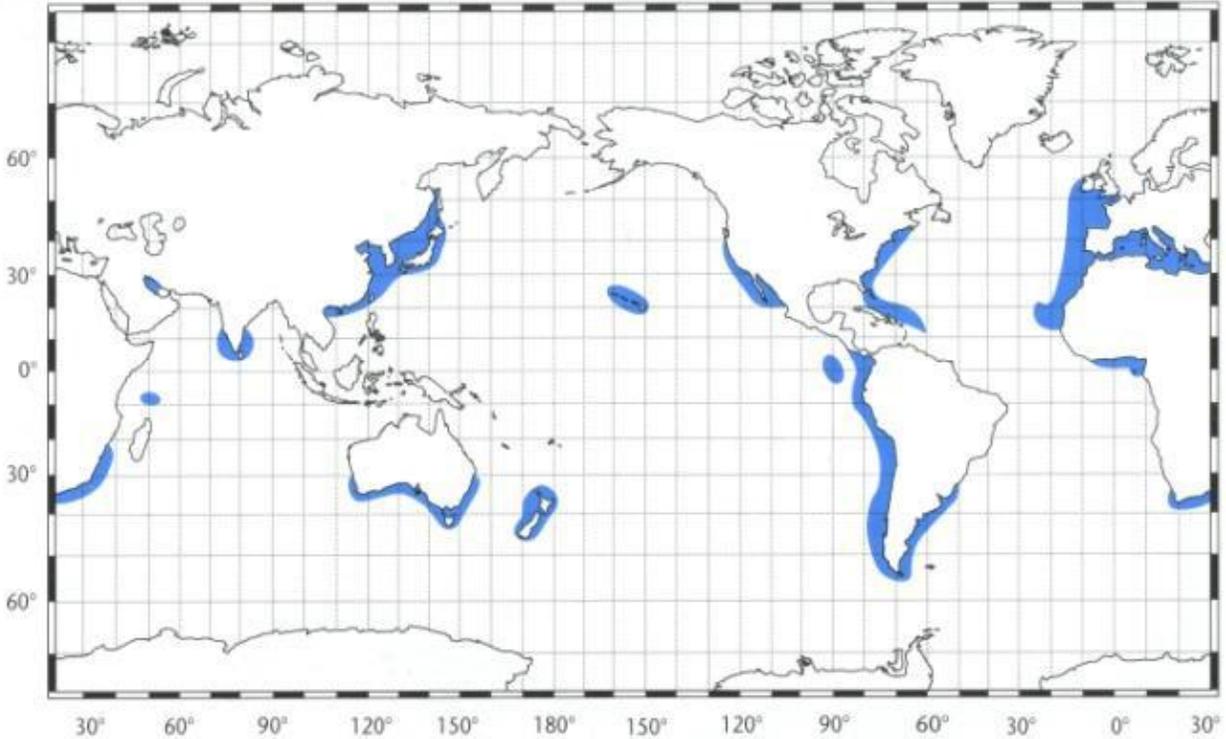


Figure 15 Distribution of the Smooth Hammerhead Shark. Reproduced from Last and Stevens (2009)

On the basis of the limited information about the genetics and movements of the Smooth Hammerhead Shark it is most likely that the population within Australian waters can be considered an isolated stock from that occurring in other nations in the Oceania region. Given the known movements of this species in other parts of the world it is likely that there is only a single stock within Australian waters.

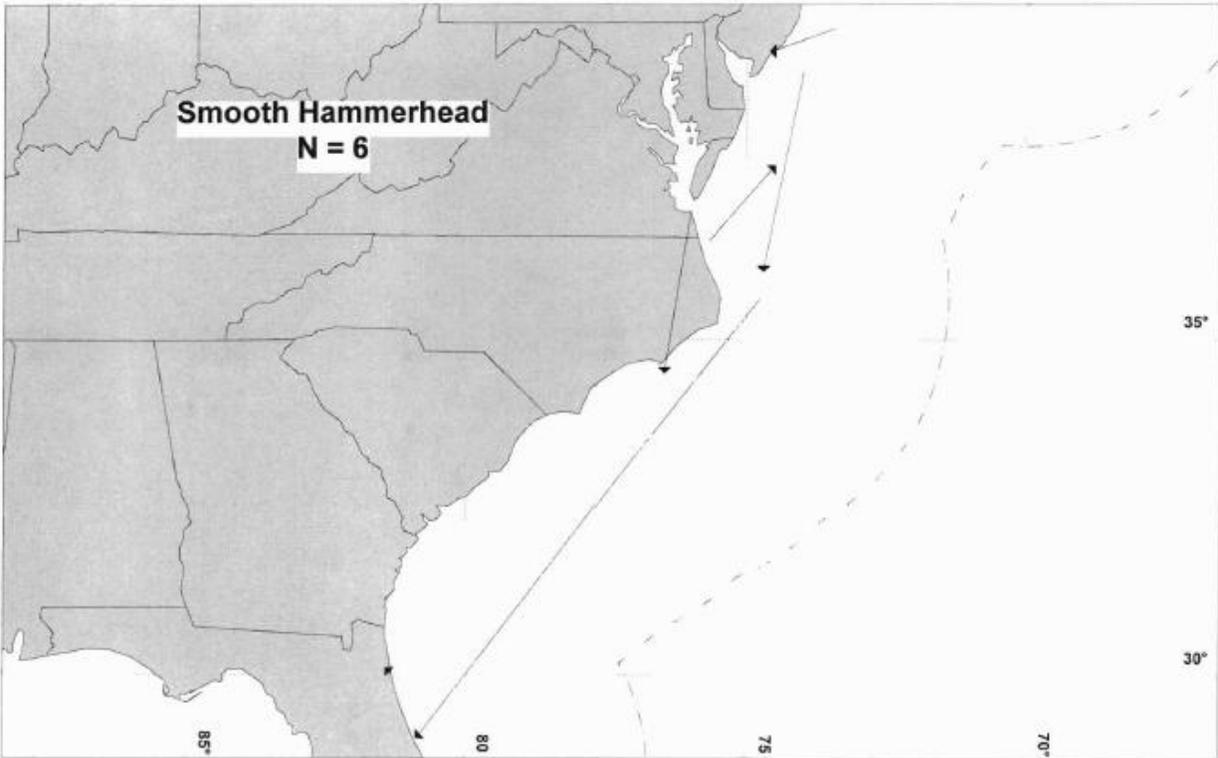


Figure 16 Movement of conventionally tagged Smooth Hammerheads on the east coast of the USA. Reproduced from Kohler (1998)

Levels of take

As with other hammerhead species the exact level of take of Smooth Hammerhead Sharks is unknown because they are often reported as all hammerheads combined. However, the limited geographic overlap with other species makes this estimation less imprecise. Detailed information about the Australian fisheries in which it occurs is provided by Koopman and Knuckey (2014). The catch is taken in three main fisheries – the Western Australian temperate gillnet fisheries (specifically the Joint Authority Southern Demersal Gillnet and Demersal Longline Fishery (JADGDLF), and the West Coast Demersal Gillnet and Demersal Longline Fishery (WCDGDLF)), the Commonwealth managed southern shark fishery (specifically the Gillnet Trap and Line sector of the Southern and Eastern Scalefish and Shark Fishery), and the New South Wales Offshore Trap and Line Fishery. Minor catches are also taken in other net and line fisheries in southern states. By far the largest catch is taken in the Western Australian fisheries. Detailed annual catch data were not available at the time of writing, but McAuley and Simpfendorfer (McAuley & Simpfendorfer 2003) estimated that between 1994 and 1999 the average annual take of hammerheads was 53 t, about 4% of the total shark take. Observer results provided in this same report confirmed that all of the catch in these fisheries is Smooth Hammerhead Shark. Given effort reductions in the fishery since this time it would be expected that the catch has declined. The take in the southern shark fishery off South Australia, Victoria and Tasmania is low, with annual catches currently between 3 t and 10 t (Table 2). Catches in minor state fisheries are of the order of 1-2 t for each of the fisheries in New South Wales and South Australia.

Table 2 Reported annual catches of Smooth Hammerhead Sharks in the Commonwealth managed Southern and Eastern Scalefish and Shark Fishery. Data supplied by Department of the Environment.

Year	Reported catch (kg)
2003	9384
2004	4021
2005	7252
2006	7611
2007	7151
2008	3594
2009	10333
2010	10197
2011	3676
2012	1587

Minor catches of Smooth Hammerhead Shark are taken in recreational fisheries in southern states (Cheshire et al. 2013). However, there are no detailed data available to estimate exact catch levels. Hammerheads, including Smooth Hammerheads, are the most common group taken in the New South Wales Shark Meshing Program (Reid et al. 2011). Between 1990 and 2010 1331 hammerhead sharks were captured. However, the exact species composition of the catch is unknown as individual species are not recorded. Marshall (2011) reported that Smooth Hammerhead Sharks have been reported in seized foreign IUU catches within the Australian EEZ, making up 3.3-5.4% of the take.

Population levels

Little data is available on the population levels of Smooth Hammerhead Sharks in Australian waters. The Fisheries Department of Western Australia provided catch per unit effort (CPUE) for hammerheads taken in the JASDGDLF and WCDGDF since 1989/90 (Figure 17). These data show that CPUE has risen steadily over time. This has been attributed to an increasing proportion of catch in these fisheries being identified to species rather than an increase in abundance (R McAuley, Western Australian Department of Fisheries, pers. comm.). However, these data do suggest that abundance has not declined over time. Limited data from 1994 to 1999 provided by McAuley and Simpfendorfer (2003) show no change for research or fishery catch per unit effort on a regional basis in temperate Western Australian waters. This suggests that catch was below the levels that would lead to population decline. The relatively low levels of catch, and their persistence over time, also suggest that there have not been major declines in this species. Given that the stock in Australian waters is likely to be separate from that of other nations within the Oceania region their catches will have no bearing on the status of this species.

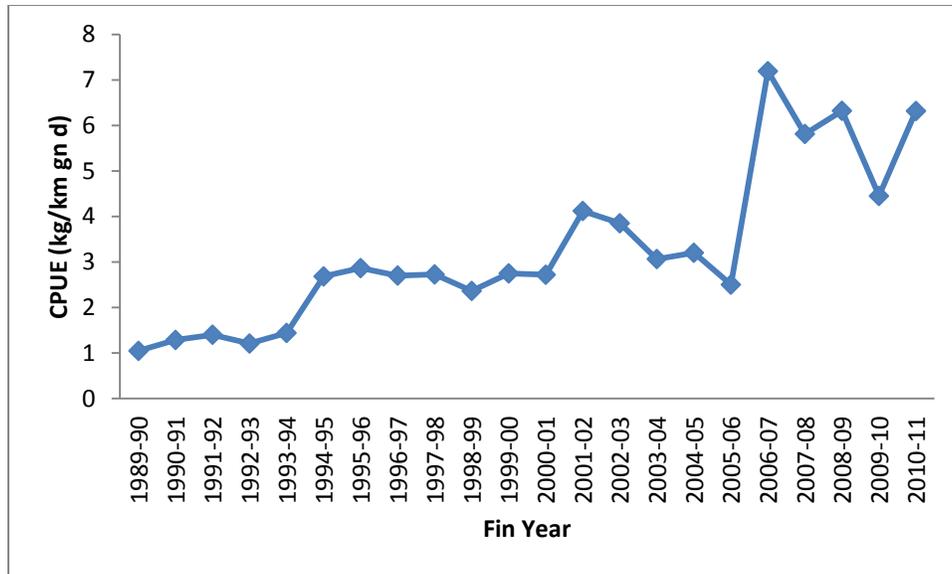


Figure 17 Catch per unit effort of hammerheads in the temperate gillnet and longline fisheries off Western Australia. Smooth Hammerhead makes up >99% of the catch in these fisheries. Data supplied by Western Australian Department of Fisheries.

Sustainable catch limits

The sustainable take levels for the purposes of Australia producing NDFs for these shark species given below are in estimates of whole weight. The export products from these species are mostly fins, which represent only a small portion of the total weight (2-8%). The exception to this is the Porbeagle Shark for which flesh is also traded from some southern hemisphere countries, mostly to Europe. It is unlikely given Australia's minimal take of Porbeagle Shark that its flesh is currently exported.

Oceanic Whitetip Shark

On the basis of the assessments from both the Pacific and Indian Oceans (see above), and the decisions by WCPFC and IOTC to ban the retention of this species the recommended sustainable catch limit is zero. This reflects that fact that in both oceans there is substantial evidence that this species is currently overfished, with overfishing still occurring. It is likely that with continued fishing for tunas in the region there is unlikely to be any rapid improvement in the status of this stock. Give the presumed stock structure of the Oceanic Whitetip Shark Australia should consider working with other nations in the Oceania region to ensure a consistent approach to NDFs. This will have the greatest benefit to the recovery of this population.

Porbeagle Shark

Given Australia's minimal catch of Porbeagle Sharks it would be possible to set the sustainable take level for the purposes of the NDF to some small level above the current level of take (~10 t). The very low level of current catch means that it is likely that take could be increased without affecting the sustainability of the stock. However, this species is currently listed as a *migratory species* under the EPBC Act because it is listed on Appendix II of the Convention on Migratory Species. This listing means that approvals for export are not currently granted, and as such the production of an NDF would not be appropriate.

Scalloped Hammerhead Shark

The lack of a stock assessment for Scalloped Hammerhead Sharks makes it impossible to provide a science-based estimate of sustainable catch. The fact that catch rate series show substantial declines suggests that populations are reduced compared to pre-exploitation levels. The lack of shark fishing in northern Western Australia over the past 5-8 years may have provided something of a refuge, but their wide ranging movements are likely to mean that this is only temporary. As such a precautionary approach should be taken to setting a sustainable take level for the purposes of developing an NDF. Current data suggest that the present Australian levels of take are not likely to lead to rapid depletion of the stock and that continued take at the lower limit of the normal take (~200 t) would be appropriate while an assessment for this species was carried out. However, if there are large catches of this species in neighbouring countries that share the stock with Australia then this could result in more rapid depletion of the stock and require a reduction in the sustainable take level. Further work is urgently required to understand the level of connection between Australia and its neighbours. It should also be noted that this species is currently being assessed for threatened species listing under the EPBC Act. If

this species is listed then this may have some effect on the ability of fishers to take this species and require an adjustment to the sustainable take limit. The species has also been nominated for listing on the Convention on Migratory Species, which may also affect regulations that control both landings and export.

Great Hammerhead Shark

The lack of a stock assessment means that there are no science-based estimates of sustainable take for Australian waters. Analysis of catch rates off Queensland and Western Australia suggest that the populations may be well below their pre-exploitation levels. However, this does not mean that they are not being fished at sustainable levels. The lack of species specific reporting of catches also means that it is impossible to know the exact levels of take. Thus while catch rates have declined, there is no evidence that the populations are at dangerously low levels. However if there is significant exchange with neighbouring nations where shark catches are much higher, then this would add to concerns about the stock.

Without a science-based estimate of sustainable take it is recommended that fishing continue while work towards an improved knowledge of the status of Great Hammerhead Sharks is undertaken. In the short-term catches at these levels are unlikely to cause further declines in stock. A catch limit that reflects the lower level of recent current catches (~100 t) is probably most appropriate. The use of the lower side of current catch estimates reflects the current level of concern for this species, which is being considered for listing under the EPBC Act as a look-a-like species for potentially threatened Scalloped Hammerhead Sharks

(<http://www.environment.gov.au/biodiversity/threatened/nominations/comment/great-hammerhead>).

The species has also been nominated for listing on the Convention on Migratory Species, which may also affect regulations that control both landings and export.

Smooth Hammerhead Shark

The lack of a stock assessment means that it is impossible to estimate the sustainable take of this species. However, given that there are no indicators that stock levels are below that which would provide for sustainable take, it is recommended that the sustainable limit for the purposes of the production of the NDF be at the current levels of take at around 70 t per year. Further work to more accurately obtain information on the status of the stock and sustainable take levels is required. It is possible that increases in catch could occur and the stock remains sustainable. However, as a precaution increases in the sustainable take level for NDF purposes should only occur when improved information on stock status is available. It should also be noted that this species is being considered for listing under the EPBC Act as a look-a-like species for potentially threatened Scalloped Hammerhead Sharks

(<http://www.environment.gov.au/biodiversity/threatened/nominations/comment/smooth-hammerhead>). The species has also been nominated for listing on the Convention on Migratory Species, which may also affect regulations that control both landings and export.

Towards NDFs for the Oceania region

The production of non-detriment findings (NDFs) for CITES Appendix II listed species is an integral part of allowing trade to continue. Article IV of CITES says that an export permit can only be issued if the “Scientific Authority of the State of export has advised that such export will not be detrimental to the survival of that species”. The NDF is therefore the document that provides the basis for the issuing of export permit. Further, Article IV also requires: “A Scientific Authority in each Party shall monitor both the export permits granted by that State for specimens of species included in Appendix II and the actual exports of such specimens. Whenever a Scientific Authority determines that the export of specimens of any such species should be limited in order to maintain that species throughout its range at a level consistent with its role in the ecosystems in which it occurs and well above the level at which that species might become eligible for inclusion in Appendix I, the Scientific Authority shall advise the appropriate Management Authority of suitable measures to be taken to limit the grant of export permits for specimens of that species.” Thus to ensure legal export of Appendix II listed species each exporting nation (=party) must have the capacity to produce an NDF, monitor the exports and respond if exports exceed levels that will be detrimental to the survival of a species.

Within the context of the Oceania region there are a number of issues in relation to the export of Appendix II listed shark species that need to be recognized:

1. The region is dominated by small island nations with limited populations and resources. This means that the capacity to carry out the requirements for export may be limited. This limits their ability to comply with CITES requirements if Appendix II listed shark species are to be exported. This will require the development of capacity within these nations to ensure that shark stocks remain viable.
2. At least some of the species of shark listed on Appendix II have stocks that are shared by nations in the region (see sections above). As such the assessment of species, setting of sustainable take levels and monitoring of the exports relative to sustainable take, are more logically fulfilled at the region level than at the national level. However, the issuing of NDFs and export permits is the responsibility of individual nations. Given the limited capacity within nations, and the need to consider region-wide stocks collectively in relation to sustainable take and status, a regional level approach to the development of NDFs and the associated assessments of status and sustainable catch levels would be logical.
3. Some parts of the Oceania region are beyond the jurisdictions of nations and so landings of Appendix II listed species require an Introduction from the Sea certificate that verifies that the take will not be detrimental to the species survival. Given the shared stocks in the region the issuance of this certificate would need to be considered in the regional context, including all of the takes from nations within the stock boundary. If a region-wide approach was developed then it would also be sensible to include the high-seas areas, and the nations that fish them.
4. There are several region-wide institutions that provide capacity in relation to some aspects of the production of NDFs and associated processes. This includes the Secretariat of the Pacific Community (SPC - <http://www.spc.int/>), Pacific Islands Forum Fisheries Agency (FFA - www.ffa.int) and Western Central Pacific Fishery Commission (WCPFC - <http://www.wcpfc.int/>). The latter two of these institutions are focused primarily on tuna fisheries, which although they are the main catcher of sharks in the region are not responsible for all take. SPC has a wider remit than tuna fisheries and so has greater capacity to deal with the breadth of issues related to shark catches in the region.

5. Within the region two nations – Australia and New Zealand – have the scientific and management resources to carry out the requirements of the production of NDFs and monitoring of exports. They also have the capability to help other nations in the region to develop capacity and carry out region-wide tasks such as research and capacity development.

The above demonstrates that there is a need for good coordination within the Oceania region for the processes related to the export of products from Appendix II listed shark species. Further, it could be argued that joint regional action to assess the status of species at the regional level and produce templates of national NDFs would help address capacity limitations and ensure the best outcome for sustainable shark stocks. This could include region-wide research, monitoring and assessment, development of enforcement capability, information sharing and more. Below the information requirements for implementing a coordinated approach to dealing with CITES listed sharks within the region are explored.

While the coordinated approach to CITES shark management within the Oceania region is sensible, there are one or two issues that need to be highlighted that could present challenges to its full implementation and smooth operation. The most obvious of those is that in situations where the export of product is determined to be detrimental how would take be reduced on a nation by nation basis. This is essentially equivalent to an allocation issue in fisheries. In other words, if exports were to be limited, then if there is a regional level of take that is determined to be sustainable, how is that allocated between the nations within the region and those that operate on the high seas and issue Introduction from the Sea certificates. Solutions to this issue could be potentially contentious because there are different models for achieving allocation, each of which could have a different outcome for each nation. Given this, if a regional strategy was developed then it would be important to reach an agreement on how to deal with national allocation prior to implementation.

Development of a regional approach to NDFs

There is no prescriptive model for the production of NDFs for Appendix II listed species. In fact, nations are not required to publish their NDFs, even though many do. To assist nations with the development of NDFs for the newly listed shark species the German government and TRAFFIC have produced a guide. This detailed guide provides a framework for the development of an NDF and suggested information to be included. The guide recommends a staged approach to development of the NDF (Figure 18). This document could form the basis of the development of a regional NDF template and/or the development of national NDFs within the Oceania region. Building capacity within the Oceania region in the use of this guidance would be a critical step in the implementation of appropriate processes around the trade in Appendix II listed species and in the production of suitable NDFs.

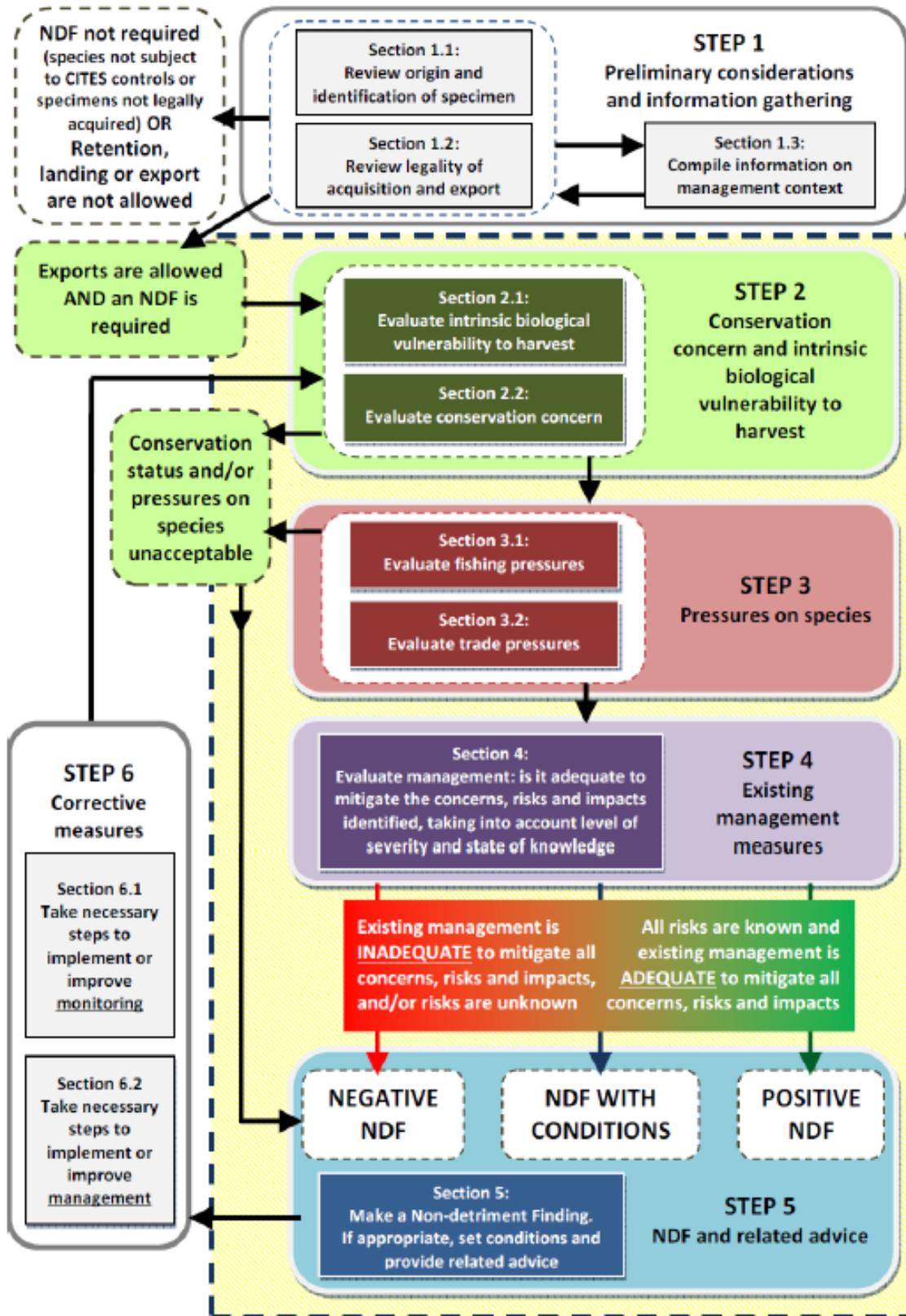


Figure 18 Flow chart illustrating the process of producing an NDF. Reproduced from Munday-Taylor et al. (2014)

Of the six steps in the German guidance, the first two are one-off or occasional requirements and could be mostly achieved at an Oceania region levels because of the likelihood that the Appendix II listed species are shared stocks. Step three is likely to be the one that requires the most intensive ongoing data collection and assessment. This will require the ongoing stock assessment of these species, which will need to be informed by ongoing data on catch, effort, discards, etc. from each of the nations in the region. The assessment process will also require some one-off or occasional data such as information on life history, stock structure and boundaries, and fishing gear characteristics. Step four requires the evaluation of the management arrangements and will largely be informed by the results of Step three and an assessment of the current management arrangements in place through WCPFC, FFA and individual nations. Step five is the production of the actual NDF. Within a cooperative regional approach with shared stocks the production of a standard NDF template for the region, populated with the same information that individual nations could use to complete a finalized national NDF, would make optimal use of the limited resources and capacity available, reduce the burden on individual nations and ensure consistency across the range of the shared stocks. The final step in the guidance is a feedback loop to ensure continued improvement in the collection of data, assessment of status and implementation of management.

Given the above, Figure 19 provides a model for the development and ongoing maintenance of NDFs for Appendix II listed shark species at the Oceania regional level. This is further explored in the following sections.

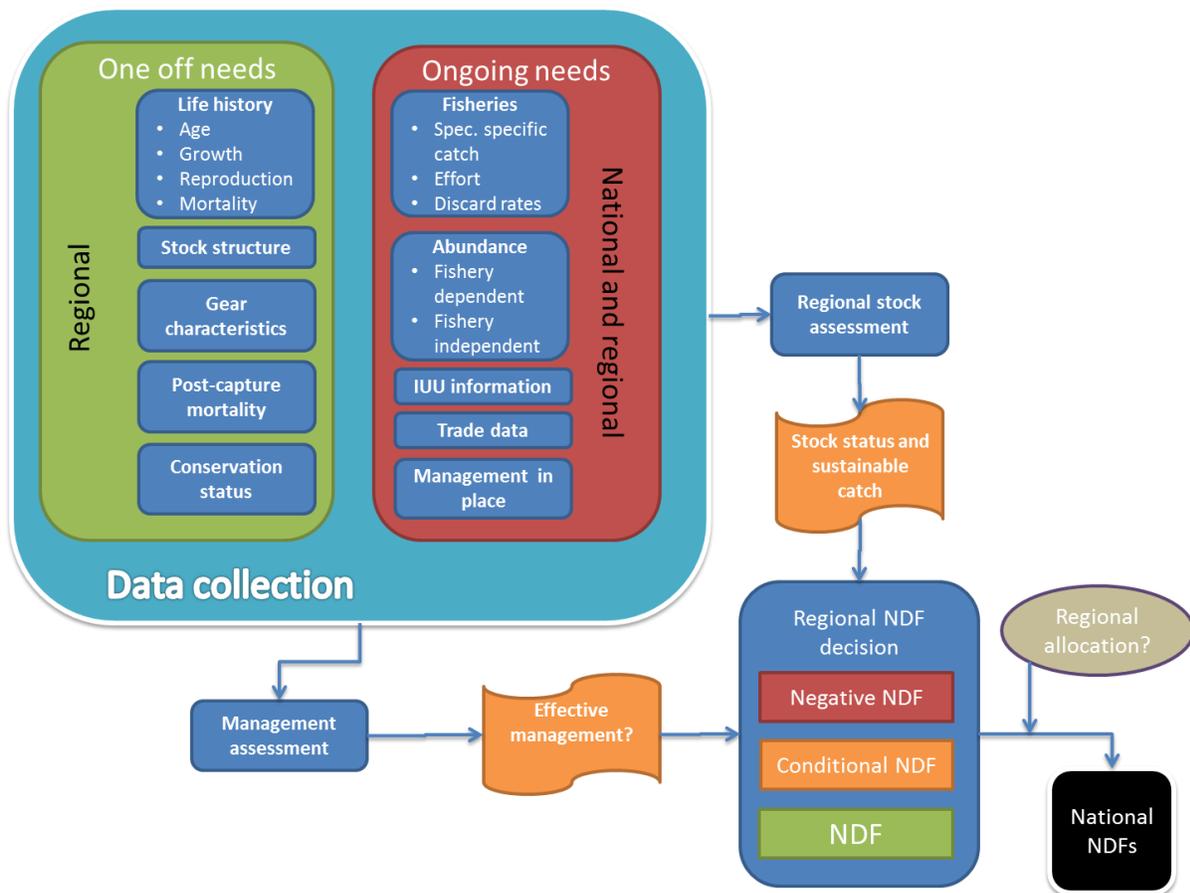


Figure 19 Model for the development and ongoing maintenance of NDFs in the Oceania region.

Information requirements for NDF development

There are a wide range of information requirements for the development of NDFs that relate to the trade, management and status of the species involved. Given the nature of the Oceania region and the shark species involved, the collection of data can be divided into four categories as outlined in Table 3. These include the division of information required at the national and regional level, and between one-off or occasional collection and regular ongoing collection. The identification of data collection requirements at the regional level is important as it can dramatically reduce the burden on individual nations where the capacity and resources available are limited. This allows these nations to focus on the provision of more critical ongoing data collection. The collection of regional level data is probably best coordinated by organisations such as SPC that have existing regional connections and capacity, and/or by nations such as Australia and New Zealand that have with the capacity and resources. Given the capacity and resource limitations of many of the small island nations there is also likely to be a need for capacity development activities to ensure appropriate data are available to the assessment processes that need to occur.

Table 3 Information needs for NDF production and their collection requirements

		Spatial scale	
		National	Regional
Frequency of collection	One-off or irregular	<ul style="list-style-type: none"> • Identification of sources of catch in coastal fisheries • 	<ul style="list-style-type: none"> • Conservation status • Life history - including age, growth, reproduction and mortality • Stock structure and boundaries – using genetics, telemetry, tagging and other approaches • Fishing gear characteristics and selectivity • Post-capture survival – using observer data, physiology and telemetry
	Regular	<ul style="list-style-type: none"> • Fishery statistics – including species –specific catch data; often collected or supplied by regional bodies • Species-specific discard rates • Abundance data • Trade data • Compliance data • National management measures 	<ul style="list-style-type: none"> • Assessment of status of stocks • Regional management measures – FFA, WCPFC

Process requirements for NDF production

The German guidance on NDFs identifies a number of processes that need to occur. Some of these are one-off processes that can be achieved relatively easily, while others are ongoing processes that will require considerable resources and capacity (e.g. stock assessments). The initial one-off process requirements, such as the determination of biological vulnerability and conservation concern could be addressed at a regional workshop, with much of this information already existing. This regional workshop could also consider the design of the ongoing process requirements, data collection needs and responsibilities, and timetable for completion of the later stages (including the frequency with which ongoing processes should be undertaken).

The processes around Step three of the guidance is largely focused on the assessment of the status of the Oceania stocks of the listed species. Given the share nature of the stocks of the Appendix II listed species these processes are probably best handled by regional bodies who have the capacity to do so. Two of the species have been assessed, or are being assessed currently. The Oceanic Whitetip Shark is already being assessed in the region as part of the WCPFC work on the bycatch of pelagic fisheries. This assessment was carried out by scientists at SPC. The Porbeagle Shark is currently undergoing assessment under a CCSBT initiative based mostly on work by New Zealand scientists. There is currently no regional or national level assessment in place for any of the hammerhead sharks. Given the distribution of Smooth Hammerhead Sharks mostly restricts them to more temperate areas their main occurrence is in Australia and New Zealand. As such these nations have the capacity to carry out separate assessments as required, or to undertake a joint assessment at the regional scale. The remaining two hammerhead species are likely to have limited (or no) stock structure in the region and should be assessed at that spatial scale. Thus it would seem sensible that a regional body such as SPC would have responsibility for the ongoing assessment. It should be noted that the availability of data for a regional assessment is very limited and thus it may take several years to develop an assessment of the status. In the interim a strategy for targeted data collection would need to be implemented. An interim assessment would also need to consider how an NDF was framed given the limited data.

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