Conservation Services Programme

Protected Fishes Medium-Term Research Plan

DRAFT

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Conservation Services Programme

Department of Conservation

1. Purpose

The Conservation Services Programme (CSP) undertakes research to understand and address the effects of commercial fishing on protected marine species in New Zealand fisheries waters (CSP Strategic Statement).

This CSP Protected Marine Fishes Medium-Term Research Plan (the plan) outlines a rolling five-year research programme to deliver on the protected fish population, mitigation and interaction research component of CSP. It has been developed as part of the work of the CSP Research Advisory Group (CSP RAG) and will be used in the development of CSP Annual Plans and any other relevant delivery mechanisms. Protected fishes include some sharks, rays and teleost species.

Development of the plan has been guided by the objectives of the CSP, Te Mana o te Taiao - Aotearoa New Zealand Biodiversity Strategy 2020, and the National Plan of Action for the Conservation and Management of Sharks 2024 (NPOA-Sharks). It has also been informed by relevant scientific research including Francis & Lyon (2012, 2014), Francis & Sutton (2012), Jones & Francis (2012), Francis (2013), Howard (2015), Francis (2017a, b), Francis & Jones (2017), Parker & Rexer-Huber (2019), Finucci et al. (2020, 2021, 2022), and qualitative risk assessment and threat classifications for New Zealand sharks and rays (Ford et al. 2018; Duffy et al. 2024 in review; Finucci et al. 2019).

Research falling outside the scope of CSP, including bycatch of protected species by recreational fishers, is not covered by this plan.

2. CSP objectives

A. *Proven mitigation strategies are in place to avoid or minimise the effects of commercial fishing on protected species across the range of fisheries with known interactions.*

B. *The nature of direct effects of commercial fishing on protected species is described.*

C. *The extent of known direct effects of commercial fishing on protected species is adequately understood.*

D. *The nature and extent of indirect effects of commercial fishing are identified and described for protected species that are at particular risk to such effects.*

E. *Adequate information on population level and susceptibility to fisheries effects exists for protected species populations identified as at medium or higher risk from fisheries.*

3. Protected marine fishes

Marine fishes protected in New Zealand waters are listed in Table 1. Protection under the Wildlife Act 1953 covers the Territorial Sea and Exclusive Economic Zone, joint protection under the Fisheries Act 1996 extends protection to New Zealand vessels fishing on the High Seas.

Prohibitions on retention, trans-shipment, and landing of oceanic whitetip sharks (*Carcharhinus longimanus*) have also been adopted by the following regional fisheries management organisations (RFMOs):

- International Commission for the Conservation of Atlantic Tunas (ICCAT)
- Inter-American Tropical Tuna Commission (IATTC)
- Western and Central Pacific Fisheries Commission (WCPFC).

Cetorhinus maximus, *Carcharodon carcharias*, *Carcharhinus longimanus* and *Mobula* spp. are listed on Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Protection of these species under the Wildlife Act (1953) means that CITES export permits or re-export certificates will only be issued for the export of specimens and samples of these species for scientific research or possibly cultural use.

Table 1. Conservation status of protected marine fishes. Alternative common names and synonyms given in brackets.

Common names	Scientific Name	Family	Protecting Legislation	NZTCS Status	Qualifier	IUCN Red List status (Global)
Whale shark	*Rhincodon typus*	Rhincodontidae	Wildlife Act 1953	Migrant	Threatened Overseas	Endangered (decreasing population)
Deepwater nurse shark (smalltooth sand tiger)	*Odontaspis ferox*	Odontaspididae	Wildlife Act 1953	At Risk – Naturally Uncommon	Threatened Overseas	Vulnerable (decreasing population)
Basking shark	*Cetorhinus maximus*	Cetorhinidae	Wildlife Act 1953 Fisheries Act 1996	Threatened – Nationally Vulnerable	Threatened Overseas	Vulnerable (decreasing population)
Great white shark (white shark, white pointer)	*Carcharodon carcharias*	Lamnidae	Wildlife Act 1953 Fisheries Act 1996	Threatened – Nationally Endangered	Data Poor, Threatened Overseas	Vulnerable (population trend unknown)
Oceanic whitetip shark	*Carcharhinus longimanus*	Carcharhinidae	Wildlife Act 1953 Fisheries Act 1996	Migrant	Threatened Overseas	Critically endangered (decreasing population)
Giant manta ray	*Mobula birostris*	Mobulidae	Wildlife Act 1953	Data deficient	Threatened overseas	Vulnerable (decreasing population)

Common names	Scientific Name	Family	Protecting Legislation	NZTCS Status	Qualifier	IUCN Red List status (Global)
(Oceanic manta ray)	*(Manta birostris)*					
Spinetailed devil ray	*Mobula mobular* *(M. japanica)*	Mobulidae	Wildlife Act 1953	Data Deficient	Stable Overseas	Threatened (population trend unknown)
Spotted black grouper	*Epinephelus daemelii*	Serranidae	Wildlife Act 1953	Not Threatened	Threatened Overseas	Near Threatened (population trend unknown)
Giant grouper (Queensland grouper)	*Epinephelus lanceolatus*	Serranidae	Wildlife Act 1953	Vagrant	Threatened Overseas	Data Deficient (decreasing population)

4. Threat classification and risk assessment

Threat classification

The conservation status of all known New Zealand chimaeras, sharks and rays was reassessed in 2024 (in review).

Great white shark (*Carcharodon carcharias*)

This species was classified as Nationally Endangered due to the estimated population size of the East Australian-New Zealand population (Blower et al. 2012; Duffy et al. 2012; Bruce et al. 2018; Hillary et al. 2018). Genetic mark-recapture analyses estimated adult abundance to be between 590 and 750 individuals, and a total population of 5460 (2909–12 802) (Bruce et al. 2018). The mean adult population trend is estimated to have remained stable since the early–mid 2000s (Bruce et al. 2018). The conservation status of this species had previously been assessed as Gradual Decline based upon its low biological productivity and reported levels of bycatch in domestic commercial and recreational fisheries (Hitchmough et al. 2007).

Basking shark (*Cetorhinus maximus*)

This species was assessed as Nationally Vulnerable based upon small estimated global population, published catch estimates, and an absence of sightings of surface aggregations at coastal hot spots since the mid–late 1990s (Francis & Duffy 2002; Hoelzel et al. 2006; Francis & Smith 2010; Francis & Lyon 2012). Finucci et al. (2019) found that basking sharks met the IUCN Red List criteria for Vulnerable, noting that the level of estimated commercial catch in New Zealand fisheries is comparable to that which drove the species close to local extinction in British Columbia between 1945 to 1970. Catch per unit effort (CPUE) peaked between 1988–1991 and has been near or at zero since the mid-2000s (Francis & Sutton 2012). Given the species capacity for trans-oceanic movement, it is unknown if this reflects a change in fishing gear or practice resulting in decreased interactions with fishing vessels, a change in the distribution of basking sharks, or a true decline in abundance (Skomal et al. 2009; Francis, 2017b; Dewar et al. 2018). This apparent decline in abundance is of concern as New Zealand appears to be the Southern Hemisphere hotspot for the species. There are few records of basking shark from the Indian Ocean, and it is considered rare in Australian waters, where it is only known from scattered occurrences (Bray, 2018).

In New Zealand waters, basking sharks are mainly taken in trawl fisheries off the east and west coasts of South Island and in the Subantarctic Zone. Historical capture locations were predominantly east of Banks Peninsula, the west coast South Island between Westport and Hokitika, Puysegur, the shelf edge south and east of Stewart Island, the Snares Islands, and around the Auckland Islands (Francis & Duffy 2002; Francis & Smith 2010; Francis & Lyon 2012; Francis & Sutton 2012). Basking sharks caught off the West Coast and in the Subantarctic are mainly mature males, whereas the sharks taken off the east coast South Island are mainly immature male and females less than 7 m total length (Francis & Duffy 2002). High Seas records of basking sharks extend across the South Pacific to South America though Yatsu (1995) reported more were observed at longitudes between 150E and 150W. Yatsu (1995) also reported the capture of several very small juveniles near the Louisville Seamount Chain (37oS, 171oW). One small juvenile less than 3 m total length was seen in New Zealand waters off Cape Kidnappers, Hawkes Bay, in 1996 (Clinton Duffy, pers. obs.).

<u>Spinetailed devil ray (*Mobula mobular*)</u>

This species was assessed as Data Deficient reflecting recent evidence of breeding in New Zealand waters, the species' overlap with the skipjack purse seine fishery and the lack of robust, long-term data on bycatch (Duffy et al. in review 2024; Ford et al. 2015, 2018).

<u>Giant manta ray (*Mobula birostris*)</u>

The threat classification for this species was reviewed in 2024. Recent evidence supports that they are breeding here and are resident in New Zealand waters for 6-months of the year (Duffy et al. in review 2024). The Hauraki Gulf region was also identified in 2024 as a habitat of significance by the IUCN Specialist Shark Group.

<u>Oceanic whitetip shark (*Carcharhinus longimanus*)</u>

This species was assessed as migrant based upon a lack of evidence to suggest they breed here (Duffy et al. in review 2024). Minimal bycatch in New Zealand commercial fisheries.

<u>Deepwater nurse shark (*Odontaspis ferox*)</u>

This uncommon deep-water species was assessed as At Risk – Naturally Uncommon (Threatened Overseas) (Duffy et al. in review 2024). The deepwater nurse shark's preferred habitat appears to be deep reefs, oceanic ridges, and sea mounts between 70-900 m depth. Significant declines in abundance of the species in southern Australia have been attributed to bycatch in trawl fisheries (Fergusson et al. 2008). Occasional bycatch of this species is reported in New Zealand trawl and line fisheries and deepwater set net in orange roughy or snapper fisheries, though these may be due to misidentification.

Whale shark (*Rhincodon typus*)

This species is classified as a Migrant in New Zealand waters (Duffy et al. in review 2024). Its global IUCN Red List classification is Endangered, Population Trend – Decreasing. Combined abundance data for the Indo-Pacific and Atlantic regions suggests a greater than 50% decline in the global population over the last 75 years (Pierce & Norman 2016).

Giant grouper (*Epinephelus lanceolatus*) and spotted black grouper (*E. daemelii*)

The conservation status of giant grouper and spotted black grouper have not been assessed since 2005. The status of these species is Vagrant (Threatened Overseas) and Not Threatened (Conservation Dependent, Threatened Overseas) respectively. Abundance and size composition of spotted black grouper around mainland New Zealand is poorly documented (Francis et al. 2016). The only breeding population in New Zealand waters is thought to occur around the Kermadec Islands.

Fishery risk assessments

The risk posed to a species by fishing is a product of the biological characteristics of the species (e.g., intrinsic population growth rate) and the extent to which it interacts with fishing activity. Availability or exposure to fishing is a product of spatial and temporal overlap with fisheries and susceptibility to being caught in various fishing gear (Ford et al. 2015, 2108). Up-to-date population data is critical to the accuracy of risk assessments.

The first qualitative assessment of the risk commercial fishing posed to New Zealand sharks and rays undertaken by Ford et al. (2015) allocated the highest risk scores for protected species to basking shark, great white shark and spinetailed devil ray. Whale shark, oceanic whitetip shark and giant manta ray received the lowest risk scores possibly due to either the lack of confirmed captures in New Zealand waters (whale shark, giant manta ray), or an absence of reported captures in the five years prior to the assessment (oceanic whitetip shark). Basking shark, great white shark, and spinetailed devil ray each had an overall Risk Score of 13.5, and deepwater nurse shark had a Risk Score of 8. Although these risk scores were lower than almost all Quota Management System (QMS) sharks and many non-QMS sharks, basking shark, great white shark, deepwater nurse shark and spinetail devil ray received consequence scores of 4.0-4.5 indicating a high likelihood of actual, or potential for, unsustainable impacts (Ford et al. 2015). The overall risk and consequence scores for basking shark, great white shark and spinetailed devil ray did not change when the risk assessment was updated in 2017. Deepwater nurse shark, whale shark, oceanic whitetip shark, and giant manta ray were not reassessed in 2017 due to the small sample size/absence of reported captures in commercial fisheries (Ford et al. 2018). FNZ are undertaking an updated shark risk assessment (BYC2022-02) due for completion in February 2025.

Great white shark, basking shark, and spinetailed devil ray comprise most reported captures of protected species (Finucci et al. 2022; Francis & Duffy 2002; Francis & Smith 2010; Francis & Lyon 2012; Francis & Sutton 2012), noting that basking shark and spinetailed devil rays were only protected under Schedule 7A of the Wildlife Act 1953 in 2010, and great white sharks in 2007. Between 2008-2021 there have been 94 fisher and observer reported captures of basking sharks

(Finucci et al. 2022). Almost all have been in midwater trawl fisheries (predominantly squid) in FMAs 3, 5, & 6, whereas almost all spinetailed devil rays have been taken in the skipjack purse seine fishery (Finucci et al. 2022; Francis & Lyon 2012; Jones & Francis 2012; Ford et al. 2015, 2018). Between 2008-2021 there have been 136 fisher and observer reported captures of great white sharks predominantly in FMAs 1, 5, 6, 8 & 9 (Finucci et al. 2022). Most reported captures of great white sharks are in bottom longline, set net and trawl fisheries (Finucci et al. 2022; Francis & Lyon 2012; Ford et al. 2015, 2018). In recent years there has been a trend away from set net bycatch towards longline and trawl.

Reported commercial catches of spotted black grouper are very small, and there have been no confirmed catches of giant grouper (Francis & Lyon 2012).

Non-reporting and misidentification of all protected fishes are known to occur, particularly in fisheries with low observer coverage, meaning the extent to which reported captures reflect the actual catch of most species is unknown (Francis & Lyon 2012; Ford et al. 2015, 2018; Duffy et al. 2018; Finucci et al. 2019).

Whale shark

There has been no reported commercial catch in New Zealand. Outside of New Zealand waters, purse seines are sometimes set around tuna schools associated with whale sharks and baleen whales. Parties to the Nauru Agreement, a subregional agreement on terms and conditions for tuna purse seine fishing licences in the Western tropical Pacific, adopted a ban on setting on whale sharks in 2010. In January 2014, similar rules were extended to all waters within the Western and Central Pacific Fisheries Convention Area (Clarke 2015). As whale sharks are seldom seen prior to setting of the net, it is likely that less than one-third of purse seine interactions are prevented by this measure. Even with improved safe release methods, the mortality of whale sharks taken in Western and Central Pacific Ocean purse seine fisheries could be as high as 50% (Clarke 2015; Escalle et al. 2016). Increased sightings of whale sharks were reported to DOC in 2024 around the Poor Knights region. This may become an increasing trend related to warming seas and will need to be monitored in future years.

Basking shark

Between 2008-2021 there were 94 fisher and observer reported fisheries bycatch interactions with basking sharks from FMAs 3, 5 & 6 in trawl fisheries targeting squid (Finucci et al. 2022) predominantly around the Auckland Islands region. In 2020, 11 basking sharks were caught in the space of a few weeks, the highest since 2003 (n=15), with one vessel catching nine basking sharks (Finucci et al. 2022). This may have been the result of factors including fishing effort, headline height and fishing depth. Given only around 25% of the trawl fishing fleet are involved in basking shark interactions, this would suggest vessel specific factors are at play. Between 2008-2021, 65% of bycatch (n=23/37) was reported as either dead or alive and injured (Finucci et al. 2022), highlighting that bycatch survival rates are very poor for this species. Over the same time period, the highest non-zero catch rate for a vessel trawl fishing for squid around the Auckland Islands region was 11.4 sharks per 1000 tows but generally ranges between 0.1 – 7 sharks per 1000 tows (Finucci et al. 2022). Observed raw trawl CPUE has been at or near zero in East Coast and West Coast fisheries since the mid-2000s, whereas in the Southland–Auckland Islands region (SA) it has fluctuated around very low levels. It is not known if the low number of captures since the mid-2000s reflects changed fishing practices, a change in the regional distribution of sharks, or a true decline in abundance. Bycatch between 2008-2021 occurred at median fishing depths of around 200–540 m and data suggest a positive relationship between time of day, depth, and fisheries interactions (Finucci et al. 2022). In 2020, Finucci et. al. investigated basking shark habitat suitability from spatial distribution data and identified key areas along the continental slope, particularly along the 250 m contour along the North and South Islands.

Headline height and depth appear to be the best predictors of basking shark captures, and thus potentially offer a basis for development of mitigation measures to reduce bycatch. In the SA region, catch rates were greatest when headline heights exceeded 4 m, and when tows were in depths of 200–540 m. Constraining headline heights to less than 4 m and reducing fishing in the preferred depth range of sharks may reduce basking shark captures, but other factors, including environmental, may be influencing catch rates.

Great white shark

Between 2008-2021 there were 136 fisher and observer reported bycatch interactions with great white sharks (juvenile and adult) mostly in FMAs 1, 5, 6, 8 & 9 in trawl, bottom longline and set net fisheries (Finucci et al. 2022; Ford et al. 2015, 2018). There has been a noticeable change in the trend away from set net bycatch in recent years. This may be due to factors such as changes to set net restrictions, fishing effort, or underreporting. There was a considerable increase in bycatch rates between 2020-2021 with that time period representing 50% of the total amount caught between 2008-2021 (n=24/48) (Finucci et al. 2022). Adult population size is estimated to have been stable, or to have slightly declined, since the early–mid 2000s (Bruce et al. 2018). This assessment used population models informed by estimates derived from genetic close-kin mark-recapture (CKMR) analyses. Accurate and updated population estimates are critical to informing bycatch risk assessments. Genetic samples were obtained from fisheries bycatch, sharks killed in Australian swimmer protection programmes and from living sharks sampled by researchers. This fishery independent approach was necessitated by the absence of robust long-term fishery datasets that could be used to assess trends in abundance. The lack of fishery data for this species is due in part to non-reporting prior to protection under the Wildlife Act (1953) in 2007. Levels of non-reporting since 2007 are not known. There are occasional reports of entanglements in commercial rock lobster and cod potting float lines.

Oceanic whitetip shark

Between 1996-2018 there have been 20 bycatch events recorded for oceanic white-tip sharks in FMAs 1, 2, 9 & 10 (Finucci et al. 2022). Most are caught by longline fisheries targeting swordfish and tuna in FMA 10 (Finucci et al. 2022). The last recorded bycatch was in the surface longline fishery in FMA 9 targeting swordfish in 2018 (Finucci et al. 2022). This species is an infrequent bycatch in surface longline fisheries off northern New Zealand (Finucci et al. 2022; Francis & Lyon 2014). It is also taken by tuna purse seine fisheries in tropical and subtropical regions but there is no reported purse seine bycatch in New Zealand (Young et al. 2018).

Deepwater nurse shark

The deepwater nurse shark (also known as the smalltooth sandtiger) is taken in set net, bottom longline and trawl fisheries and is commonly misidentified as other deepwater shark species (Finucci et al. 2022). There are five records of commercial bycatch inside New Zealand's EEZ for this species between 2008-2021 in FMAs 2, 4 & 9 targeting hoki, tarakihi, scampi and ling (Finucci et al. 2022). Deepwater nurse sharks have a patchy distribution, tendency to aggregate around deep reefs, low natural abundance, and low fecundity, making it vulnerable to overfishing (Fergusson et al. 2008). A significant decline in abundance of the species in southeast Australia between 1972 and 1997 has been attributed to incidental mortality in outer shelf-upper slope trawl fisheries (Andrew et al. 1997; Fergusson et al. 2008). No robust catch or population trend information is available for this species in New Zealand waters due to non-reporting and high levels of misidentification by fishers and observers (Francis & Lyon 2012). Aggregations of deepwater nurse sharks have been documented at L'Esperance Rock, Kermadec Islands Marine Reserve, and Volkner Rocks, Bay of Plenty and there is an unconfirmed anecdotal report of an aggregation site near Tolaga Bay, East Coast. The only west coast North Island reports are of two juvenile females caught in set nets at about 40 m depth south of New Plymouth. Elsewhere within the New Zealand region the species has been recorded from Norfolk Ridge, Three Kings Islands, Kermadec Ridge, Louisville Ridge, White Island, Gisborne, off Mahia Peninsula and Lachlan Banks (Garrick 1974; Fergusson et al. 2008; Francis & Lyon 2012).

Giant manta ray

In 2021, the first ever confirmed bycatch interaction of a manta ray in New Zealand commercial fisheries was reported by a fisheries observer onboard a vessel in the FMA 1 surface longline fishery targeting swordfish (Finucci et al. 2022). Release state was deceased. There have been previous reports of bycatch which were misreported as spinetailed devil rays. In 2024, the threat classification for manta rays was reviewed (report in review not yet published). Evidence suggests they are breeding in New Zealand waters and spend around 6-months here between October – March when many migrate north to Fiji and Tonga. No population data is currently available. Tracking data from migrating manta rays tagged in New Zealand waters appears to indicate interactions with purse seine fisheries in the Indo-Pacific region. In 2024, the Hauraki Gulf region was designated as an Important Sharks and Rays Areas (ISRA) for this species after assessment by the IUCN Shark Specialist Group (SSG).

Spinetailed devil ray

Between 2008-2021, there were 264 observer and fisher reported purse seine fisheries bycatch interactions with spinetailed devil rays; with 80% (n=210) caught in FMA 1 (Finucci et al. 2022). A small number were also caught in FMA 9 (2%), and no location data was available for the remaining 18%. Nine of the thirteen purse seine vessels fishing between 2008-2021 recorded bycatch interactions with spinetailed devil rays (Finucci et al. 2022). Overall catch rates were between 5.6-8.2 per 100 fishing events with a peak of 60 for a single vessel. Improved handling and release techniques have likely contributed to a huge turn around in survival rates on release with most being recorded as alive between 2017-2021 compared with 100% mortality rates between 2008-2012 (Finucci et al. 2022). Noting that the purse seine fishery has not fished every year in FMA 1 due to low numbers of target species. Post-release survival is unknown. A study conducted shortly after the species was protected in 2010 found that post-release mortality was high, even of rays in apparently good condition (Jones & Francis 2012; Francis 2013; Francis & Jones 2017).

Modelling suggests a strong relationship between ocean currents (particularly the East Auckland Current) and bycatch rates in spinetailed devil rays (Finucci et al. 2022). Observed and fisher reported catches of spinetailed devil rays are highly variable between years likely due to environmental factors influencing their distribution and that of the target species (skipjack tuna) which also alters purse seine fishing effort between seasons. There is currently only one inshore operator of purse seine fishing vessels in New Zealand and these vessels fish in the Hauraki Gulf area where this species is vulnerable to commercial fisheries bycatch. Levels of mortality in the skipjack purse seine fishery are uncertain. Specimens of near-term embryos have occasionally been collected from purse seines indicating an additional source of mortality is the abortion of embryos during capture (Paulin et al. 1982; Stewart 2002).

Spotted black grouper

There have been infrequent commercial captures of spotted black grouper in coastal set net fisheries around the North Island and west coast South Island (Francis & Lyon 2012; Roberts et al. 2015). This species suffers barotrauma even when caught at depths as shallow as about 20 m and post-release survival has not been studied. Reported captures from fisheries operating in water depths greater than about 50 m are likely to be misidentifications of eightbar/convict grouper (*Hyporthodus octofasciatus*).

5. Information needs

In general, there is a lack of data on the biology, population size and population structure of protected fishes in New Zealand (Table 2) (Francis & Lyon 2012; Ford et. al. 2015, 2018). This section briefly summarises the information required to understand impacts of commercial fisheries on protected marine fishes and reflects information needs identified by previous CSP projects and in published scientific literature.

Whale shark

All biological parameters are poorly estimated due to a lack of access to specimens (Rowat & Brooks 2012). The species' distribution in New Zealand waters is reasonably well known from documented sightings, however movements within New Zealand waters and between New Zealand and other range states are unknown (Duffy 2002; Francis & Lyon 2012). Research is needed on changing species and prey species distribution patterns in response to climate change to identify potential for future overlap with fisheries activity.

Deepwater nurse shark

All biological parameters are poorly estimated or unknown due to a lack of access to specimens (Fergusson et al. 2008; Francis & Lyon 2012). Distribution in New Zealand waters is poorly known. Population size structure and trends, movements and stock structure are unknown. Captures in commercial fisheries are poorly documented but are known from the Bay of Plenty, including White Island and Volkner Rocks, Hawke Bay, Taranaki and Louisville Ridge (Fergusson et al. 2008; Francis & Lyon 2012; Ford et al. 2015).

Basking shark

Most biological parameters are poorly estimated due to operational difficulties associated with sampling such large animals aboard commercial fishing vessels, and the disappearance of surface schools from coastal waters. Size and age structure, and length at maturity, in New Zealand waters are poorly known. Research is required to determine if basking sharks can be aged from their vertebrae, and this is hoped to be achieved by Auckland Museum using a juvenile specimen that stranded in 2024. Difficulties include variation in the number of growth bands along the length of the vertebral column and the presence of about seven bands at birth. Other estimates of age and growth are imprecise or speculative and are based on untested assumptions (Francis & Lyon 2012). Little is known of reproduction, including size at birth (Francis & Duffy 2002; Francis & Lyon 2012).

Captures of basking sharks off the east and west coasts of South Island and elsewhere in New Zealand waters have dropped to negligible levels. Whether this reflects a change in fishing practices resulting in decreased bycatch, or a serious reduction in the natural population of sharks in those regions is unknown (Francis 2017b). Global population connectivity inferred from genetic and satellite tagging studies appears to be high, suggesting the possibility that regional declines in abundance could be due to large scale shifts in distribution (Hoelzel et al. 2006). However, genetic sampling of seasonal aggregations of basking sharks in the Northeast Atlantic has revealed unexpectedly complex population structure with high levels of relatedness within schools, and synchronous movement of groups of related individuals into and out of aggregation sites (Lieber et a. 2020). Genetic sampling of basking sharks undertaken in New Zealand waters to date has been haphazard. A more systematic approach to sampling bycaught sharks and surface schools (if these reappear in coastal waters) is required to understand the population structure of basking sharks occurring here, and their relationship to basking sharks elsewhere in the Southern Hemisphere. Efforts to increase tissue sampling from deceased bycatch is also required to add to the protected species tissue archive at Auckland Museum.

Spatial changes in the abundance of planktonic prey appear to be important drivers of basking shark distribution and abundance in other parts of the species' range and may have contributed to the decline in abundance observed here (Sims 2008; MfE & Stats NZ 2019). The lack of knowledge of basking shark diet and feeding behaviour in New Zealand makes this possibility difficult to assess. Only two non-quantitative observations of the stomach contents of individual sharks captured in shallow inshore waters have been reported from New Zealand, no stable isotope or fatty acid analyses of New Zealand basking shark tissues have been undertaken, and there is no information on the relationship between prey distribution and foraging behaviour in New Zealand waters.

Research on the environmental drivers of basking shark distribution in New Zealand waters undertaken through the Department's CSP by Finucci et al. (2020) suggests suitable basking shark habitat occurs over the upper continental slope around much of New Zealand however, data limitations (i.e. relatively small sample size; presence only; long time span – 121 years; and absence of prey distribution models north of 39°S) mean the results may be a better representation of the species' historic rather than contemporary distribution. Satellite tracking data from the Northern Hemisphere also indicate that basking sharks occupy oceanic habitats for prolonged periods during which time they seldom appear at the surface, preferring depths between 200-1000 m (Skomal et al. 2009; Braun et al. 2018; Dewar et al. 2018). The absence of data on movements, depth preferences and diving behaviour in the Southern Hemisphere means that basking shark use of oceanic habitat in the New Zealand region has not been assessed.

Bycatch outside the New Zealand EEZ, particularly in the jack mackerel fishery within the South Pacific Regional Fishery Management Organisation area, is poorly known.

No biomass estimates or information on trends in basking shark size composition are available.

Great white shark

Size and age at maturity, fecundity and reproductive periodicity are poorly defined due to their relative rarity and operational difficulties associated with sampling such large animals aboard commercial fishing vessels. Long-distance movements and regional connectivity of sub-adult and adult males, and sub-adult females tagged at aggregation sites in central and southern New Zealand are well known. Fine scale habitat use by all size and sex classes remains poorly known. Almost all aspects of the distribution, movements and ecology of mature females in the East Australian-New Zealand population are unknown.

Reconstruction of commercial catches of great white sharks is not possible due to a lack of data prior to protection and unknown levels of non-reporting following protection. No information is available on the post-release survival of great white sharks taken as bycatch in commercial fisheries in New Zealand. An attempt to investigate post-release survival in coastal set net fisheries failed due to low encounter rates and operational difficulties getting observers aboard fishing vessels. Safety constraints also make it difficult or impossible for observers to tag large great white sharks landed aboard commercial fishing vessels.

No biomass estimates or information on trends in great white shark size composition are available. Population size and trend has been estimated using genetic data (Bruce et al. 2018; Hillary et al. 2018). Regularly updated population estimates for the eastern Australasian population (of which our sharks are a part of) are needed to better inform risk assessments.

Oceanic whitetip shark

Existing growth models for the SW Pacific lack age estimates for large adults (>2m TL) and juvenile specimens. Collection of material in New Zealand waters may help improve these models.

Giant manta ray

Most biological parameters are poorly estimated due to a lack of access to specimens. Size, age structure and movements in New Zealand waters and elsewhere in the SW Pacific are unknown. The threat classification for manta rays was reviewed in 2024 (Duffy et. al., in review, 2024). In 2024, the ISRA project led by the IUCN SSG identified the Hauraki Gulf as important habitat for this species (report in publishing).

Spinetailed devil ray

Most biological parameters are poorly estimated due to a lack of access to specimens. Size, age structure and reproductive condition in New Zealand waters are poorly known (Duffy & Tindale

2018; Ford et al. 2018). Cuevas-Zimbrón et al. (2013) investigated aging spinetailed devil rays using caudal vertebrae from below the origin of the dorsal fin. While they concluded that it was feasible to age them using this method they noted the need for validation analysis, a larger sample size, and better coverage of size classes. Factors influencing capture, post-release survival and movements are poorly known (Jones & Francis 2012; Francis 2013; Francis & Jones 2017).

Structural change in the purse seine fishery since the last characterisation of fishery interactions with this species has resulted in changes in vessel size and operating practices, including handling and release methods (Francis & Lyon 2012; Jones & Francis 2012). Industry advice is that few devil rays are now landed on deck due to the absence of large vessels in the fishery, with most brailed for direct release or released over the cork-line (Pelco NZ Ltd., February 2021). The influence of these changes on devil ray bycatch and post-release survival is unknown, as are environmental factors influencing spatial and temporal variation in encounter rates with devil rays in New Zealand waters. Although devil rays frequently associate with skipjack tuna and may be caught with them, they are also observed in areas where there do not appear to be commercial quantities of skipjack (Clinton Duffy pers. obs.). Estimating spatial and temporal overlap with the skipjack purse seine fishery will be necessary for improved risk assessment.

Spotted black grouper

All biological parameters are unknown or poorly estimated due to a lack of access to specimens. Maximum age is thought to be around 65 years but no specimens approaching maximum reported size have been aged (Francis et al. 2016). Spotted black grouper have very specific habitat requirements (i.e. shallow rock or coral reef systems with caves and overhangs) which limits their distribution. However, little is known of their patterns of habitat use, residency and movements due to the rapid and early depletion of populations throughout their range (Francis et al. 2016). Size structure, abundance and population trends in New Zealand waters have not been studied. Francis et al. (2016) concluded that further genetic studies would improve understanding of source populations and recruitment processes. Better data from commercial catches and post-release survival is required.

Giant/Queensland grouper

Most biological parameters are unknown or poorly estimated. The lack of life history data prevents estimation of generation length. Spawning behaviour and most aspects of the species' ecology including movements and population connectivity are poorly known (Fennessy et al. 2018).

Table 2. Quality of information available for assessment of the effects of commercial fishing on protected marine fishes in New Zealand waters. Proportion of population in NZ: 1 = Low, 2 = Moderate, 3 = High. Information quality: 0 = none, 1 = poor, 2 = moderate, 3 = good, 4 = excellent, NA = not applicable (modified from Francis & Lyon 2012).

	Stock-Population Unit						Biological information (productivity)					
Species	Proportion of population in NZ	Genetic stock structure	Movements	World distribution	Habitat use	Sum	Growth	Longevity	Maturity	Reproduction	Natural mortality	Sum
Whale shark	1	2	2	3	3	10	1	1	1	1	1	5
Smalltooth sand tiger	2	0	0	2	1	3	0	0	1	1	0	2
Basking shark	3	1	2	3	2	8	1	1	1	1	1	5
Great white shark	3	3	3	3	3	12	2	1	2	1	1	7
Oceanic whitetip shark	1	2	1	3	2	8	3	3	3	3	2	14
Spinetailed devil ray	2	0	1	3	3	7	1	1	2	2	0	6
Giant manta ray	3	1	1	3	2	7	0	1	2	2	0	5
Spotted black grouper	3	1	0	4	3	8	2	2	1	1	2	8
Giant grouper	1	0	0	3	3	6	0	0	1	0	0	1

	Overlap with fisheries in NZ					Response to catch in NZ			
Species	Proportion of population in NZ	Stock distribution	Fishery distribution	Size class reported in catch	Sum	Catch trend	Biomass	Size composition	Sum
Whale shark	1	3	4	none	7	3	NA	NA	3
Smalltooth sand tiger	2	1	1	all	2	1	0	0	1
Basking shark	3	3	2	>4m	5	2	0	0	2
Great white shark	3	3	2	all	5	1	0	0	1
Oceanic whitetip shark	1	3	4	>1.8 m	7	1	0	0	1
Spinetailed devil ray	2	3	3	all	6	2	0	0	2
Giant manta ray	3	2	3	none	5	3	NA	NA	3
Spotted black grouper	3	3	3	all	6	1	0	0	1
Giant grouper	1	3	2	none	5	0	NA	NA	0

6. Proposed research

The following proposed projects address the knowledge gaps identified above and are intended to improve understanding of the actual and potential risks to protected fishes from commercial fishing. Species-specific projects are identified for deepwater nurse shark, basking shark, great white shark and spinetailed devil ray. Basking shark, great white shark and spinetailed devil ray are the protected elasmobranchs assessed to be at greatest risk from commercial fishing by Ford et al. (2015, 2018) and are caught in larger numbers than all other protected fishes. Great white sharks are also caught in the greatest number of fisheries. Although reported captures of deepwater nurse shark are very low, this species has shown very little resilience to bycatch in commercial fisheries elsewhere and existing commercial catch data is considered poor (Fergusson et al. 2008; Ford et al. 2015). No species-specific projects are proposed for whale shark, oceanic whitetip shark, giant manta ray, spotted black grouper or giant grouper as these species are either not caught, or caught in negligible numbers by commercial fisheries within New Zealand waters. Understanding the impact of commercial fishing on these species will be primarily achieved through periodic assessments of reported catch, observer reports, and other forms of catch monitoring.

The proposed research projects have been developed to wherever possible provide:

- improved identification of protected fishes
- improved collection of biological samples from dead specimens to enable estimation of fishery relevant life history parameters such as size and age at maturity, fecundity, growth rates and maximum age
- better understanding of population structure and connectivity within the New Zealand EEZ and elsewhere within the species' ranges
- improved understanding of spatial and temporal overlap between commercial fisheries and protected fishes
- assessment of post-release survival
- safe release methods that maximise post-release survival.

Prioritisation of projects considered:

- species risk assessments and threat classification
- existing information and information gaps
- the frequency of fishery interactions
- potential synergies with other research projects
- the potential to leverage additional resources from other programmes
- legal and logistic constraints (e.g. animal ethics, health and safety, retention of protected species, size and encounter rates)
- the need for periodic review to ensure ongoing relevance of data and sample collection.

Observer Programme

As well as providing independent information on catch, effort and fishing practices, fishery observers play an important role in documenting protected species interactions with fisheries, the efficacy of mitigation measures, obtaining data and samples from live and dead specimens, and assisting with tagging studies.

Improving the understanding of life history characteristics of protected fishes informs assessments of their conservation status and the effects of commercial fishing. Knowledge of life history parameters for most protected fishes is poor (Francis & Lyon 2012; 2014). Collection of data and biological samples from bycaught animals is often the only means of estimating characteristics such as growth and longevity, size at sexual maturity, litter size and gestation period (Francis & Lyon 2012). Data and samples that should be routinely collected from live protected species landed during commercial fishing operations includes length (total, fork and standard/precaudal length), sex and maturity (where this can be determined externally) and a fin clip for genetic analyses. In the case of sharks and rays, the number, size and sex of any aborted embryos should be recorded. Wherever possible, dead specimens should be retained and returned to shore for research. Specimens returned to the water or released alive should be tagged, either with conventional plastic streamer tags or electronic tags. All suspected protected species should be photographed to confirm identification.

The degree of post-release mortality of protected fishes in commercial fisheries is not well understood. Some fishery-species interactions have a higher incidence of live release than others, however individuals assessed as alive and in good condition at release may be subject to high levels of post-release mortality due to internal injuries or species-specific physiological responses to capture (Gallagher et al. 2014; Campana et al. 2016). For example, Francis & Jones (2014) found that spinetailed devil rays assessed by observers as in good condition upon release suffered high (75%) post-release mortality. At present, estimates of post-release mortality are only available for a relatively small sample of spinetailed devil rays that were tagged with Survival Pop-up Archival Tags (sPATs) after release from skipjack tuna purse seines (Jones & Francis 2012; Francis 2013; Francis & Jones 2017). Attempts were made by DOC in 2022/23 to work with the purse seine fishery to tag bycatch, however due to logistical constraints this work has been put on hold. In addition to increasing the sample size of devil rays tagged with sPATS, post-release survival of basking shark, great white shark, and deepwater nurse shark should be investigated using this technology (Francis 2017a, 2019; Francis & Jones 2017).

Low observer coverage in inshore fisheries means understanding of protected species interactions with these fisheries is limited. Increased observer coverage or the implementation of effective electronic monitoring technologies in these fisheries should be a priority, particularly in South Island trawl and set net fisheries where there appear to be ongoing issues of non-reporting captures of basking shark and great white shark, and west coast North Island where levels of observer coverage are low or lacking (Francis 2017a; Parker & Rexer-Huber 2019).

A prerequisite for accurate reporting of protected fish bycatch is accurate species level identification. Ongoing review of identifications, observer training, and review of observer photographs of protected species is required to maintain and improve data quality (Weaver 2019).

Deepwater nurse shark

The main problems with existing fishery data are misidentification and non-reporting, meaning knowledge of the actual bycatch in New Zealand fisheries is limited. Confirmed captures have been documented in set net and trawl fisheries around the upper North Island and on Louisville Ridge. Observer briefings should prioritise identification of this species and the need to retain dead specimens for research or collect life history data and genetic samples from specimens that cannot be retained. This species is a priority for post-release survival and satellite tagging studies. To increase the chances of success, satellite tags should be issued to fishery observers and/or fishers operating in areas where the species is known to aggregate.

Basking shark

Targeted research on basking sharks in New Zealand waters has proved difficult. The limited availability of specimens, the low chance of encountering one on a trip, and the difficulty of working on a large animal during a commercial fishery operation all hinder the collection of biological data. The disappearance of large surface aggregations of basking sharks in coastal waters has also meant that fishery independent research on distribution, abundance, size and sex structure, genetic population structure and foraging and reproductive behaviour has become impractical.

The following research activities are considered achievable given these constraints:

1. Ongoing collection of tissue samples (primarily fin clips) for genetic research on global and regional stock structure, and potentially genetic CKMR estimates of population size (Bravington et al. 2016; Francis & Ritchie 2016; Francis 2019). Priority should be given to investigating the feasibility of undertaking a CKMR estimate of the New Zealand population using existing archived tissue samples.

2. White muscle and liver samples should be collected from dead specimens for stable isotope analysis of feeding ecology. Wherever possible, a representative sample of stomach contents should be collected, and stomach fullness estimated.

3. Shark length should be measured (subject to safety considerations for live sharks) or estimated, and sex determined, for all sharks caught in commercial fisheries. Length estimates have been obtained for about 60% of observed sharks but these have rarely been sexed. Differences in size, sex, and maturity have been found between the main regions where fishery interactions occur, and it is important to monitor for any changes in these indicators (Francis & Duffy 2002). Commercial vessels should be requested to report this data.

4. Small juvenile basking sharks (≤ 2.5 m) are virtually unknown in the scientific literature. Dead juveniles should be retained for scientific study.

5. Whenever possible, vertebral samples should be collected from dead specimens, including beach cast carcasses, for research on aging and ontogenetic changes in habitat use using stable isotopes. Data on reproductive status should be collected at the same time.

6. Should surface aggregations reappear in coastal waters every effort should be made to deploy popup satellite tags on free-swimming sharks to study long-distance movements, depth and temperature preferences and diel and seasonal patterns of habitat use. The use of eDNA may also support studies of habitat use through presence/absence data. Length and sex composition of surface schools should be documented, and biopsy samples taken for research on genetic population structure and trophic ecology. In the interim, the feasibility of satellite tagging sharks caught during commercial fishing operations should be reassessed.

7. Given known problems with age estimates obtained from vertebrae, consideration should be given to developing an alternative aging methodology, potentially epigenetic aging (Parrott &

Bertucci 2019). This is likely to require the use of model species such as mako and/or porbeagle sharks to determine if it is possible to develop an accurate alternative aging method for Lamniforme sharks.

Great white shark

Long-distance movements of sub-adult and adult male, and sub-adult female white sharks aggregating at pinniped colonies of the Chatham Islands and Foveaux Strait (Ruapuke, Tītī Islands) are well known. Residency of white sharks at Tītī Islands has also been studied using an acoustic array. Gaps in knowledge of the species' spatial ecology include details of fine scale habitat use in coastal waters, and movements of juveniles (<3m TL) and adult females (>4.5 m TL).

Tagging white sharks with dorsal fin-mounted satellite tags (SPLASH and SPOT5 tags) at Stewart Island and in Kaipara and Manukau Harbours has provided little or no information on fine scale habitat use. Once white sharks arrive in coastal foraging areas, they become bottom orientated and spend much less time at the surface, greatly limiting the frequency and accuracy of position fixes obtained. A subsequent trial of tethered Wildlife Computers SPLASH10-321A satellite tags around 2020/21 in the Kaipara and at the Chatham's failed to overcome this problem and only revealed sharks moving in and out of those areas. Tags had high failure rates due to premature release and breakage and sharks did not surface often enough to ascertain fine scale habitat use. Therefore, these tags didn't perform any better than a dorsal fin mounted SPLASH or SPOT tag. Whilst easier to deploy, the SPLASH10 tags are also at a higher risk of entanglement and require anti-biofouling before fitting. Presently, acoustic tracking of sharks remains the best possible solution for fine-scale studies of habitat use.

Understanding the nature of interactions between great whites and bottom longline and trawl fisheries should be a priority, including gear operating parameters (e.g. fishing depth, time of day etc.). Bycatch numbers have increased considerably for great white sharks, but we know very little about 'how' they are being caught and why some vessels are more likely to catch them than others. Post-release survival studies are also required to understand the true impact of fisheries bycatch on the population along with greater understanding of their distribution patterns, especially with warming oceans and changing prey species distribution.

Whilst we are currently seeing a trend away from bycatch in set net fisheries, it is worth mentioning that Francis (2017a) identified the following set net research priorities:

(i) identification of areas where overlap with fisheries is high, and
(ii) investigation of post-release mortality.

With respect to the post-release mortality study, Francis noted the low encounter rate was likely to mean that the duration would have to be 3-5 years to ensure sufficient data was obtained.

Size and age at maturity and reproductive periodicity are poorly defined due to a lack of access to specimens. The large size of sub-adult and mature white sharks (females mature between 4.0-5.2 m TL and c. 800-1650 kg) means it can be difficult, expensive, and potentially dangerous for fishers to retain and land carcasses of sharks that die in their gear. Wherever possible, data on length, sex, reproductive condition and tissue and vertebral samples should be collected from dead great white sharks of all sizes.

Spinetailed devil ray

Spinetailed devil rays are primarily taken as bycatch in the skipjack tuna purse seine fishery. A review of fishery interactions and investigation of post-release mortality conducted shortly after the species was protected in 2010 documented regular, sometimes large, catches and high mortality (Jones & Francis 2012; Francis 2013; Francis & Jones 2017). However, changes to the purse seine fleet and operational practices that have occurred since mean it is likely that encounter rates and mortality of spinetailed devil rays have changed. Research is required to understand temporal and spatial overlap of the population with the skipjack purse seine fishery, the factors influencing bycatch (e.g. vessel size, net type and size, fishing practices, environmental drivers, climate phenomena) and how bycatch has varied over time. Research is also required to better understand if current handling and release practices (i.e., direct release by brailing or over the cork-line) improve post-release survival. If possible, post-release survival of rays handled according to the operational procedure for large purse seine vessels should also be assessed (Sanford Ltd. et al. 2019). To maximise data obtained on movements, habitat preferences and diving behaviour the investigation of post-release survival should involve tagging released rays with standard pop-off archival satellite tags (PAT) as well as survival tags (sPAT). A representative number of free-swimming spinetailed devil rays should also be tagged with PATs as controls for released rays and to allow determination of recovery times for released rays.

As age, growth and reproductive parameters of spinetailed devil rays are poorly known and dead specimens should either be retained for scientific research, or data on size (disc width, disc length), sex and reproductive condition should be collected at sea. A section of the vertebral column should be collected for aging by removing the tail from the ray just in front of the dorsal fin. The dorsal fin should be left attached so the location of vertebrae used in aging studies can be determined relative to its origin and/or insertion. Priority should be given to obtaining vertebral samples from spinetailed devil rays approaching maximum size (i.e. 3.1 m disc width). All rays sampled for aging and post-release survival studies should be photographed to confirm species identification. It is possible that more than one spinetailed devil ray species occurs off northern New Zealand, and small manta rays could be misidentified as spinetailed devil rays. All aborted embryos should be retained for research.

Table 3. Proposed CSP research response over the next 5 years: INT= Interactions with fisheries, includes observing commercial fisheries and collection of biological data and samples by fishery observers; POP=Population abundance and trends, includes estimation of life history parameters used to assess resilience to fishing; MIT= Mitigation methods; SURV= Post-release survival; LIVE= Live release methods; TRACK= Tracking and habitat use, includes estimation of overlap with fisheries; GEN= Genetic population structure.

Species	Research	2024/25	2025/26	2026/27	2027/28	2028/29
Basking shark	INT					
	POP					
	MIT					
	SURV					
	LIVE					
	TRACK					
	GEN					
Deepwater nurse shark	INT					
	POP					
	MIT					
	SURV					
	LIVE					
	TRACK					
	GEN					
Oceanic whitetip shark	INT					
	POP					
	MIT					
	SURV					
	LIVE					
	TRACK					
	GEN					
Whale shark	INT					
	POP					
	MIT					
	SURV					
	LIVE					
	TRACK					
	GEN					
Great white shark	INT					
	POP					
	MIT					
	SURV					
	LIVE					
	TRACK					
	GEN					
Manta ray	INT					
	POP					
	MIT					
	SURV					
	LIVE					
	TRACK					
	GEN					
Spinetailed devil ray	INT					
	POP					
	MIT					
	SURV					
	LIVE					
	TRACK					
	GEN					
Giant grouper	INT					
	POP					
	MIT					
	SURV					
	LIVE					
	TRACK					
	GEN					
Spotted black grouper	INT					
	POP					
	MIT					
	SURV					
	LIVE					
	TRACK					
	GEN					

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Appendix 1. Goals and objectives of the NPOA-Sharks 2024

Table 1: Goals and objectives of the NPOA-Sharks 2024

Goal	Objectives
Section A: Managing the effects of fishing - goals enabled by the Fisheries Act 1996	
Biodiversity and ecological long-term viability of shark population 1. Maintain the biodiversity and long-term viability of New Zealand shark taking into account their role in marine ecosystems.	**Objective 1.1** Further develop and implement a risk assessment framework to identify the nature and extent of risks to shark species and populations and their functional role within the ecosystem, and support prioritisation of research and management actions. **Objective 1.2** Systematically review shark management categories, New Zealand threat classifications and protection status to ensure they are appropriate to the risks facing individual shark species whilst incorporating mātauranga Māori. **Objective 1.3** Identify and protect sites of significance for maintaining the long-term viability and diversity of shark populations. **Objective 1.4** Taking an ecosystem approach to fisheries management, catch limits for QMS stocks are set appropriately in relation to the maximum sustainable yield (MSY) or accepted management targets and reference points. **Objective 1.5** Mortality of protected sharks from fishing is at or below a level that allows for their long-term viability.
Ensure full utilisation of retained sharks 2. Encourage the legal full utilisation of retained sharks that are brought on-board dead, and maintain the prohibition on shark finning in New Zealand.	**Objective 2.1** Ensure no shark finning is occurring in New Zealand fisheries through ongoing compliance monitoring and enforcement. **Objective 2.2** Promote full utilisation of landed shark products, excluding shark fins, by promoting research into new products and markets.
Avoiding protected and unwanted shark captures, and maximising post release survival 3. Encourage behaviour to avoid unwanted shark catch, focussing on protected species in the first instance, and maximising live release when unavoidable catch occurs.	**Objective 3.1** Promote behaviour to avoid catching protected and unwanted shark species in all New Zealand commercial fisheries. **Objective 3.2** Promote behaviour to avoid catching protected and unwanted sharks in all New Zealand non-commercial fisheries. **Objective 3.3** Maximise live release and minimise harm to protected and unwanted shark species in all New Zealand commercial fisheries. **Objective 3.4** Encourage compliance with legislation and promote best practice behaviour to minimise harm and maximise live release of protected and unwanted shark species in all New Zealand non-commercial fisheries.

Goal	Objectives
Section B: Goals enabled by legislation other than the Fisheries Act 1996	
Non-fishing threats 4. Anthropogenic effects other than direct fisheries impacts are not adversely affecting the viability of New Zealand shark populations.	**Objective 4.1** Significant and sensitive shark habitats within the Territorial Sea and EEZ are protected through statutory planning and consenting processes. **Objective 4.2** Adverse effects of marine debris on sharks are minimised. **Objective 4.3** Biosecurity measures consider the impact of harmful pests and diseases on shark species and are consistent with Biosecurity New Zealand Import Health Standards. **Objective 4.4** The potential effects of global climate change and ocean acidification on sharks in New Zealand waters are understood and considered in planning and consent processes.
Section C: Cross-cutting and overarching goals	
Better Integration of Tangata Whenua Perspectives and Value 5. Fisheries New Zealand and the Department of Conservation will enhance their engagement with Māori as the Treaty Partner, to ensure that Māori aspirations regarding utilisation and/or protection of shark taonga and aspects of mātauranga Māori are incorporated into the management of sharks.	**Objective 5.1** Engagements with Māori will capture the social and cultural significance of sharks to Māori, their perspectives on methods for the sustainable utilisation of, and management practices and aspects of mātauranga Māori relating to sharks as taonga species. **Objective 5.2** Agencies will continue to work with Māori to provide opportunities for input and participation in the development of communication and information sharing strategies that promote the conservation and sustainable management of shark populations.
International Engagement 6. New Zealand engages internationally to promote the conservation and management of sharks, including through enhanced monitoring, data collection and information sharing.	**Objective 6.1** New Zealand advocates internationally for the development, adoption, implementation, and improvement of best-practice shark conservation and management measures. **Objective 6.2** New Zealand works to build regional capacity and capability for the conservation and management of sharks. **Objective 6.3** New Zealand proactively contributes to and advocates for enhanced monitoring, improved data collection and information sharing of commercial catches and incidental bycatch of protected and unwanted sharks within relevant Regional Fisheries Management Organisations (RFMOs) and the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR).
Research, Data and Information 7. Continuously improve the data available to conserve sharks and manage fisheries that impact on sharks, with prioritisation guided by the Spatially Explicit Fisheries Risk Assessment (SEFRA) framework and conservation threat status.	**Objective 7.1** Ensure adequate monitoring and data collection for all sectors (including commercial, recreational, and customary fishers and non-extractive users) to inform management of shark populations. **Objective 7.2** Undertake a research programme to increase understanding of shark populations (e.g. biology, stock status, functional role within ecosystems, non-fishing anthropogenic impacts and habitats of particular significance). **Objective 7.3** Undertake a research programme to improve knowledge of how to avoid unwanted catch and minimise harm to sharks. **Objective 7.3** Utilise taxonomic studies to confirm species composition and distribution, linking it to the risk assessment process so that priority is given to resolving the taxonomic status of undescribed species for which there are conservation/sustainability concerns.

Appendix 2. Relative ranking of protected shark species according to risk from fisheries bycatch from Ford et al. (2015)

Relative ranking of protected shark species according to risk from fisheries bycatch, based on the reviewed Level 1 Qualitative Risk Assessments in (a) 2016 and (b) 2017. For the COMPONENTS OF RISK higher numbers indicate greater intensity or consequence of impact. For RISK longer bars and larger numbers indicate higher risk, and for CONFIDENCE more ticks indicate higher confidence in the data, or greater consensus and a cross indicates a lack of consensus (two ticks in the consensus column indicate full consensus). Where species scored identical risk scores, they are presented so that higher consequences are reported first and then in alphabetical order (after Ford et. al., 2018).

(a) 2015 Qualitative (Level 1) risk assessment

PROTECTED SPECIES RISK

COMPONENTS OF RISK		RISK	CONFIDENCE	
Intensity	Consequence		Data	Consensus
3	4.5	13.5 - Basking shark	✓✓	✓
3	4.5	13.5 - Spinetail devil ray	✓	✓
3	4	12 - Great white shark	✓✓	✓
2	4	8 - Smalltoothed sandtiger	✓	✓
1	1	1 - Whale shark	✓✓✓	✓✓
1	1	1 - Oceanic whitetip shark	✓✓✓	✓✓
1	1	1 - Manta ray	✓✓	✓✓

(b) 2017 Qualitative (Level 1) risk assessment

PROTECTED SPECIES RISK

COMPONENTS OF RISK		RISK	CONFIDENCE	
Intensity	Consequence		Data	Consensus
3	4.5	13.5 – Basking shark	✓✓	✓
3	4.5	13.5 – Spinetail devil ray	✓	✓
3	4	12 – Great white shark	✓✓	✓