Conservation Services Programme

Protected fish medium term research plan

February 2016

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 species, in New Zealand fisheries waters (for further details see the CSP Strategic Statement 2015). Protected fish species are those listed under Schedule 7a of the Wildlife Act 1953 and detailed in Table 1

This CSP protected fish medium term research plan (CSP fish 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 fish research that falls outside the scope and mandate of CSP, for example recreational fishing bycatch, is not included in this plan.

2. Guiding objectives and risk framework

This plan is guided by the relevant objectives of CSP and relevant elements the National Plan of Action for the Conservation and Management of Sharks 2013 (NPOA-Sharks). These are summarised in Table 2.

The risk referred to in the guiding objectives is the risk of commercial fisheries to New Zealand protected fish populations. One objective of the NPOA-Sharks is to undertake a quantitative risk assessment in order to understand the impact of commercial fisheries on shark species. While the methodologies for this qualitative risk assessment are being developed in interim level 1 quantitative risk assessment has been conducted The risk assessment was conducted by an expert panel comprising representatives from DOC, MPI the fishing industry and NIWA (Ford et.al 2015). 84 shark taxa were considered in the risk assessment, including all protected fish sharks and rays. While assessment criteria for all shark species were the same protected sharks and rays were considered separately as they are afforded special status under the Wildlife Act. The objective of the risk assessment was not to assigns low, medium and high categories to species rather to provide a scoring which will inform species priority relative to others, this process of risk assessment also provides a broad gaps-analysis for each species.

The Department intends to conduct a review of the New Zealand Threat Classification for all elasmobranchs during mid 2016. The outputs of this will further inform prioritisation and potential inclusion it Schedule 7a of the Wildlife Act 1953.

The prioritisation in this plan combines the results of the level 1 risk assessment with the results of Francis and Lyon (2012; 2014) alongside any other relevant information.

3. Data requirements

In general there is a paucity of data relating to the population structure of protected fish species in New Zealand. Francis and Lyon (2012; 2014) summarise the current state of knowledge for all nine protected fish species (Table 3) and give direction as to where priority research should be focused. This was largely echoed by the preliminary relative rankings of the Level 1 Risk Assessment detailed in Table 4 (Ford et. al., 2015).

This plan describes a research approach to fill knowledge gaps in order to better understand protected fish species susceptibility to impacts from commercial fisheries and therefore inform and prioritise management actions to avoid, remedy or mitigate these impacts:

- A core prerequisite for any research on protected fish is accurate identification of bycaught animals to the most appropriate taxonomic level. Historically a number of shark species have be reported to generic taxonomic levels by both observers and fishers. This has generally been a result of cryptic morphology between a number of species and limited effort targeted at identifying animals due to conflicting observer priorities. In some cases the ability for fishers to report captures has been hampered by a lack of species specific codes, for example a reporting code for oceanic white-tip shark was not available prior to its protection.

- In order to accurately assess risk of fishing as a function of overlap with commercial fisheries developing accurate species distributions are required. For migratory species these distributions should contain seasonal dimensions. For many, more commonly caught, fish taxa this can be achieved through catch data. However for the seven protected shark species this data will be too sparse therefore where possible should be supplemented with tracking studies.

- Sharks can be characterised as having relatively slow growth rates, late sexual maturation and low fecundity. These factors place them at increased risk of impact from commercial fishing bycatch. Understanding the reproductive characteristics of protected sharks in New Zealand allows understanding of the resilience of populations to such fishing impacts. Very little information is available on growth rates or fecundity for either spotted black grouper or giant grouper, however it is generally believed to be low based on the characteristics of other similarly sized grouper species (Francis and Lyon 2012). Therefore, caution should be applied when estimating risk form commercial fisheries interaction.

- The degree of post-release mortality in commercial fisheries is not well understood for fish species. Some fishery/ species interactions have higher incidence of live release than others, for example white pointer sharks bycaught in setnets and spine tailed devil rays bycaught in purse seine. While animals are assessed as being alive at time of release the level of subsequent mortality is poorly understood. Sharks are susceptible to toxic poisoning due to stress and recent studies by Francis and Jones (2014) have shown that post-release mortality of spine-tail devil rays, assessed by observers as in good condition on release, can be high (75% based on a very limited sample). This methodology should be applied to other protected fish species in order to refine assessments of mortality.

- Other sources of information, particularly around estimation of capture rates in fisheries, is also of great importance in accurately estimating risk. This information is generally best obtained via vessel observation programmes. Preliminary information has been included in this plan that can be used in setting observer and mitigation priorities.

4. Current risk and uncertainty

While a formalised quantitative risk assessment for shark species has not yet been completed the results of the Level 1 risk assessment (Table 4) give guidance and a preliminary matrix of fisheries and protected fish species can be constructed based on known interactions with fisheries. This can be used to prioritise data gathering to better understand interactions including bycatch rates and where to target mitigation. Two matrices are presented in Tables 5 and 6, to aid with this prioritisation of population. Data needs are species specific and dependant on both our understanding of the nature of interactions and the population dynamics and distribution of the species.

Not all protected fish species have been reliably reported as interacting with commercial fisheries in New Zealand; whale shark, manta rays and giant grouper are tropical species which are not know to occur in New Zealand waters regularly or in high numbers. Therefore these species would be lower priority candidates for research (Francis and Lyon 2012). This was reflected by Ford et. al (2015) in the relative rankings of protected shark species according to risk from anthropogenic impact, primarily fisheries bycatch (Table 4). Basking shark and spine tailed devil rays are the most frequently reported bycatch species followed by white pointer sharks. All protected fish, with the exception of spine tailed devil ray and spotted black grouper[1] are listed as vulnerable under the IUCN Redlist classification system (Table 1).

Observed interactions with spine-tailed devil rays are largely limited to skipjack purse seine fisheries, and over a relatively short season. As this fishery aims for live capture of fish, many of the animals are recorded as caught and released alive (Francis and Lyon 2012) though studies have shown post release mortality occurs even for apparently good condition individuals (Francis 2013). Therefore projects targeted at mitigation, safe release and education and/ awareness could yield reductions in captures and/or increased post-release survival.

Reported basking shark interactions by contrast are the most evenly distributed over time, space and fishery group (Francis and Sutton 2012). It is likely that no single mitigation approach will deal with these interactions. Therefore it will be necessary to better understand

[1] Listed as 'Near Threatened'

the distribution and population dynamics of this species to better target actions to avoid or mitigate commercial fisheries bycatch.

White pointer sharks have been reported captured in both inshore and offshore trawl fisheries but primarily in inshore setnet around Stewart Island, Fiordland and Taranaki. Given the sparse nature of observer coverage in these fisheries it will be important to increase monitoring in order to better understand the nature and extent of these interactions. A number of these shark interactions are reported as resulting in live releases, however it is uncertain as to the level of post release mortality. These data gaps would best be filled through the use of pop-off or survival tags to record the animal's activity following release.

Bycatch of oceanic white-tip sharks has been reported in surface longline fisheries, in northern New Zealand and the Kermadec region. Understanding of the nature and extent of these interactions has been limited by a combination of a lack of species specific reporting codes available to fishers and low (<10%) and patchily distributed observer coverage in the domestic surface longline fisheries (Ramm 2011, 2012, 2013, Rowe 2010). Increased focus on data collection for observers in this fishery along with studies on post release survival would help inform future management action or research. Acknowledging that there would be an underreporting rate for this species Francis and Lyon 2014 still found that it is likely that these sharks are rarely caught and therefore a lower priority for management.

Improving understanding of life history characteristics of shark species informs assessments of their vulnerability to fisheries related mortality. Collection of biological samples from bycaught animals can be used in the estimation of these life history characteristics for example; growth and longevity, size at sexual maturity, litter size and gestation period (Francis and Lyon 2012). Such data is poor for most protected fish species (Francis and Lyon 2012; 2014).

5. Research planning

Table 3 indicates the knowledge gaps in our understanding of population parameters relevant to meeting CSP and NPOA-Sharks objectives. Prioritisation of these data gaps will be further informed by work underway on the quantitative NPOA-Sharks Risk Assessment. This risk assessment is planned to be completed in a series of iterations. The initial stage, a Level 1 expert based assessment, has been completed (Ford et. al., 2015). A first tranche of species will be run through a Level 2, semi quantitative, assessment in order to prove the concept with more data rich species. Once the approach in refined it will then be applied to less data rich species. Each iteration will be reviewed by a technical working group and will identify data gaps which will drive the research direction. With each iteration, more species will be added and models will be refined with improved input data.

The information on our understanding of population parameters for protected fish, relevant to NPOA-Sharks and CSP objectives, given in Table 3 and the relative prioritisation of shark species in Table 4 forms the basis of the CSP research response proposed in Table 7. The CSP research response has been developed to meet the following criteria:

- Method and species specific bycatch mitigation options developed for each protected fish species known to interact with commercial fisheries.

- Development of live release methods and protocols to maximise post-release survival probability of protected fish species for fisheries where live captures are relatively frequent.

- Where protected fish species are known to be released alive following capture, assess post-release survival to better estimate bycatch mortality.

- Population structure should be determined (by genetic analysis) in order to identify both population structuring within the NZ EEZ and differentiation from worldwide populations. This will enable adequate population level management.

- Improvement of both government observer and commercial fisher identification of protected fish species though training and educational materials to improve catch assessment for protected species. This should be informed by review of historic observer identification and photo logs.

- Optimise sampling of biological materials from protected fish, including collection of vertebrae and gonads to inform New Zealand specific understanding of life history characteristics such as age at maturity and fecundity.

- Leveraging any international initiatives to investigate population dynamics through collaboration and provision of bycatch samples for the purpose of genetic analysis.

- Tracking studies of highly motile protected fish species to inform estimates of spatial overlap between commercial fisheries and protected fish species. These studies should be designed to be informative on seasonal movements.

In order to plan a five-year research programme to deliver the CSP research response described in Table 7, some further operational principles were developed and used as appropriate:

- studies on highest risk species prioritised for earlier years, as informed by Level 1 and in, the future, Level 2 risk assessments;

- mitigation, live release and post release survival studies should focus on fisheries with most frequent interactions;

- annual grouping of CSP projects by location across protected species taxa, in order to maximise synergies with other research projects, for example vessel based research in the Auckland Island squid fishery can assist both sea lion and basking shark research;

- planning live release, survival estimation and tracking studies in a complementary manner;

- aim to leverage from existing studies, of both the Department and other organisations;

- prioritise taxonomic and review projects, ensuring adequate data collection is advanced in early years, as these are relatively low cost and may result in finding current risk estimates are under-estimated for potential new taxa; and
- prioritise studies which make better use of existing research platforms such as biological sampling by government observers.

6. References

Ford, R.B.; Galland, A.; Clark, M.R.; Crozier, P.; Duffy, C.A.J.; Dunn, M.R.; Francis, M.P., Wells, R. (2015). Qualitative (Level 1) Risk Assessment of the impact of commercial fishing on New Zealand Chondrichthyans. New Zealand Aquatic Environment and Biodiversity Report No. 157. 111 p.

Francis, M. P., Lyon, W. (2012). Review of Commercial fishery interactions and population information for eight protected fish species. *Report prepared for the Conservation Services Programme*. Available at http://www.doc.govt.nz/Documents/conservation/marine-and-coastal/marine-conservation-services/pop2011-03-protected-fish-review.pdf

Francis, M. P., and Lyon, W. S. (2014). Review of commercial fishery interactions and population information for the oceanic whitetip shark, a protected New Zealand species. Report prepared by the National Institute of Water and Atmospheric Research for the New Zealand Department of Conservation, Wellington. 15p.

Francis, M. P., Sutton, P. (2012). Basking shark bycatch review. *Report prepared for the Conservation Services Programme*. Available at http://www.doc.govt.nz/Documents/conservation/marine-and-coastal/marine-conservation-services/pop2011-04-baskings-shark-by-catch-review-final-report.pdf

Francis, M. P. (2013). Survival and depth distribution of spinetail devil rays (*Mobula Japanica*) released from purse-seine catches. *Report prepared for the Conservation Services Programme*. Available at http://www.doc.govt.nz/Documents/conservation/marine-and-coastal/marine-conservation-services/reports/mit2011-01-tagging-report-final.pdf

Ramm, K. C. (2011). Conservation Services Programme Observer Report for the period 1 July 2008 to 30 June 2009. Available at www.doc.govt.nz/documents/science-and-technical/2008-09-csp-observer-report.pdf

Ramm, K. C. (2012). Conservation Services Programme Observer Report for the period 1 July 2009 to 30 June 2010. Available at www.doc.govt.nz/documents/conservation/marine-and-coastal/marine-conservation-services/csp-observer-report-2009-10.pdf

Ramm, K. C. (2013). Conservation Services Programme Observer Report for the period 1 July 2010 to 30 June 2011. Available at http://www.doc.govt.nz/Documents/conservation/marine-and-coastal/marine-conservation-services/csp-observer-report-%202010-2011.pdf

Rowe, S.J. (2010). Conservation Services Programme Observer Report for the period 1 July 2007 to 30 June 2008. DOC Marine Conservation Services Series 4. Department of Conservation, Wellington. 97p

Tables

Table 1. Protected fish species

Common name	Scientific Name	Family	IUCN Threat Ranking
Basking shark	*Cetorhinus maximus*	Centorhinidae	Vulnerable
Deepwater nurse shark	*Odontapsis ferox*	Odontaspididae	Vulnerable (decreasing population)
Oceanic whitetip shark	*Carcharhinus longimanus*	Carcharhinidae	Vulnerable
Whale shark	*Rhincodon typus*	Rhincodontidae	Vulnerable (decreasing population)
White pointer shark	*Carcharodon carcharias*	Lamnidae	Vulnerable
Manta ray	*Manta birostris*	Mobulidae	Vulnerable
Spinetail devil ray	*Mobula japanica*	Mobulidae	Near Threatened
Giant grouper	*Epinephelus lanceolatus*	Serranidae	Vulnerable
Spotted black grouper	*Epinephelus daemelii*	Serranidae	Near Threatened

Note: these species have not yet been assessed against the revised New Zealand Threat Classification System 2008 so IUCN Redlist classifications are used.

Table 2. Guiding objectives of the NPOA-Sharks and CSP.

NPOA-Sharks

Goal	Five-year objectives
Biodiversity and long-term viability of shark populations 1. Maintain the biodiversity and long-term viability of New Zealand shark populations based on a risk assessment framework with assessment of stock status, measures to ensure any mortality is at appropriate levels, and protection of critical habitat.	Objective 1.1 Develop and implement a risk assessment framework to identify the nature and extent of risks to shark populations. Objective 1.2 Systematically review management categories and protection status to ensure they are appropriate to the status of individual shark species. Objective 1.3 For shark species managed under the QMS, undertake an assessment to determine the stock size in relation to B_{MSY} or other accepted management targets and on that basis review catch limits to maintain the stock at or above these targets. Objective 1.4 Mortality of all sharks from fishing is at or below a level that allows for the maintenance at, or recovery to, a favourable stock and/or conservation status giving priority to protected species and high risk species. Objective 1.5 Identify and conserve habitats critical to shark populations. Objective 1.6 Ensure adequate monitoring and data collection for all sectors (including commercial, recreational and customary fishers and non-extractive users)) and that all users actively contribute to the management and conservation of shark populations.
Utilisation, waste reduction and the elimination of shark finning 2. Encourage the full use of dead sharks, minimise unutilised incidental catches of sharks, and eliminate shark finning[2] in New Zealand	Objective 2.1 Review and implement best practice mitigation methods, as required, in all New Zealand fisheries (commercial and non-commercial). Objective 2.2 Minimise waste by promoting the live release of bycaught shark species, and develop and implement best practice guidelines for handling and release of live sharks. Objective 2.3 Develop and implement best practice guidelines for non-commercial fishing and handling of sharks. Objective 2.4 Eliminate shark finning in New Zealand fisheries by 1 October 2016.

[2] Shark finning is defined for the purpose of this NPOA as the removal of the fins from a shark (Class Chondricthyes – excluding Batoidea (rays and skates)) and the disposal of the remainder of the shark at sea. As such, removal of the fins from a shark where the trunk is also retained for processing is not defined as 'shark finning'.

Goal	Five-year objectives
Domestic engagement and partnerships 3. All commercial, recreational and customary fishers, non-extractive users, Maori, and interested members of the New Zealand public know about the need to conserve and sustainably manage shark populations and what New Zealand is doing to achieve this.	Objective 3.1 Capture and reflect, through meaningful engagement, the social and cultural significance of sharks, including their customary significance to Maori, in their conservation and management. Objective 3.2 Communication and information sharing between government agencies and stakeholders is effective, with strategies developed and implemented to promote the conservation and sustainable management of shark populations. Objective 3.3 Encourage compliance with regulations, implementation of best practice (including catch avoidance and correct handling), and cooperation with ongoing research among commercial and non-commercial stakeholders. In particular, encourage reporting of any illegal practices (especially live finning) that may be observed.
Non-fishing threats 4. New Zealand's non-fishing anthropogenic effects do not adversely affect long-term viability of shark populations and environmental effects on shark populations are taken into account	Objective 4.1 Non-fishing anthropogenic and environmental threats to shark populations are understood and, where appropriate, managed.
International engagement 5. New Zealand actively engages internationally to promote the conservation of sharks, the management of fisheries that impact upon them, and the long-term sustainable utilisation of sharks.	Objective 5.1 New Zealand ensures that it meets its international obligations and receives positive recognition for its efforts in the conservation, protection and management of sharks through active engagement in international conservation and management agreements relevant to sharks. Objective 5.2 New Zealand actively investigates and decides whether to become a signatory to the Convention on Migratory Species (CMS) Memorandum of Understanding on the Conservation of Migratory Sharks (MoU) in advance of the next Meeting of Signatories in 2015. Objective 5.3 New Zealand collaborates with neighbouring countries to better understand the population dynamics of highly migratory sharks, protected sharks and any other shark species of special interest. Objective 5.4 New Zealand proactively contributes to and advocates for improved data collection and information sharing of commercial catches and incidental bycatch of sharks within relevant Regional Fisheries Management Organisations (RFMOs). Objective 5.5 New Zealand encourages fishing countries, coastal States, and other regional organisations to develop and implement best practice Plans of Action for conserving and managing sharks, where they have not already done so.
Research and information 6. Continuously improve the information available to conserve sharks and manage fisheries that impact on sharks, with prioritisation guided by the risk assessment framework.	Objective 6.1 Ensure information collection systems and processes are sufficient to inform management of shark populations Objective 6.2 Undertake a research programme, guided by the risk assessment framework, to increase understanding of and improve the management of shark populations. Objective 6.3 Implement research to inform the development of recovery plans appropriate to protected species

CSP Objectives

Objective 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.	Addressing this objective will consist of continued identification of new mitigation methods, application of methods used overseas (including development for New Zealand fisheries), and at-sea testing. Priority will be given to protected species/fisheries interactions for species identified as at high risk from commercial fishing effects.
Objective B: The nature of direct effects of commercial fishing on protected species is described.	This objective will be achieved through the collection and reporting of observational information on captures and other direct interactions of protected species across a representative portion of fishing effort. The protected species involved, the characteristics of the fishing operation, and the nature of each interaction will be determined and recorded.
Objective C: The extent of known direct effects of commercial fishing on protected species is adequately understood.	This objective will be achieved when: • a robust risk assessment can be completed to assess the extent of risk posed by direct effects of commercial fishing; • for species identified at medium or high risk[3], information is available to allow the meaningful monitoring of captures rates over time; and • the extent of commercial fishing effects that allow for the protection and recovery of protected species have been identified. Addressing this objective will require the collection of representative independent information on interaction rates of protected species with commercial fishing, at levels determined through risk analysis.

[3] These risk categories will be determined during the prioritisation phase of the CSP research planning cycle, with reference to relevant risk assessments as detailed in Section 3 and Appendix 4.

Objective 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.	Addressing this objective will involve multi-disciplinary research including ecosystem modelling focussed on identifying and describing the mechanisms of indirect effects from fisheries on protected species. Priority will be given to those relevant protected species/fisheries combinations where existing knowledge or related research programmes exist.
Objective 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.	This information is required in order to inform detailed risk assessment and/or fisheries management. Addressing this objective will involve the collection of data on population trend, demographic parameters and at-sea foraging information for medium to high risk protected species.

Table 3. Summary of the level of population information available for each of eight protected fish species. Species and their score sums which are coloured purple have a moderate–high proportion of their population in New Zealand waters for at least part of the year (Francis and Lyon 2012).

		Stock identification - population unit					Biological information - species productivity					
Species	Proportion of stock in NZ	Genetic stock structure	Movement	World distribution	Habitat	Sum	Growth	Longevity	Maturity	Reproduction	Natural mortality	Sum
Basking shark	High	1	2	3	2	8	1	1	1	1	1	5
White shark	High	3	3	3	3	12	2	1	2	1	1	7
Whale shark	Low	2	2	3	3	10	1	1	1	1	1	5
Deepwater nurse shark	High?	0	0	2	1	3	0	0	1	1	0	2
Spinetail devilray	Moderate	0	1	3	3	7	1	1	2	2	0	6
Manta ray	Low?	1	1	3	2	7	0	1	2	2	0	5
Spotted black grouper	High	1	0	4	3	8	2	2	1	1	2	8
Giant grouper	Low	0	0	3	3	6	0	0	1	0	0	1
Sum		8	9	24	20		7	7	11	9	5	

		Species and fishery distribution - extent of overlap in NZ				Response to exploitation in NZ		
Species	Proportion of stock in NZ	Stock distribution	Fishery distribution	Vulnerable components in commercial fisheries	Sum	Catches and biomass	Size composition	Sum
Basking shark	High	3	2	> 4 m	5	2	0	2
White shark	High	3	2	All	5	0	0	0
Whale shark	Low	3	4	Not vuln.	7	NA	NA	
Deepwater nurse shark	High?	1	1	All	2	0	0	0
Spinetail devilray	Moderate	3	3	All	6	0	0	0
Manta ray	Low?	2	3	Not vuln.	5	NA	NA	
Spotted black grouper	High	3	3	All	6	0	0	0
Giant grouper	Low	3	2	Not vuln.	5	NA	NA	
Sum		21	20			2	0	

Information level
- 0 = none
- 1 = poor
- 2 = moderate
- 3 = good
- 4 = excellent
- NA = not applicable

Table 4 Relative ranking of protected shark species according to risk from fisheries bycatch, based on preliminary outputs of the Level 1 Qualitative Risk Assessment. 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., 2015)

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	✓✓	✓✓

Table 5.. Frequency of interaction between fishery group and protected fish species in each FMA for the period 1990 to 2011. Taken from the merged data set of fisher and observer reports used in Francis and Lyon 2012

Species/Fishery Group	FMA 1	2	3	4	5	6	7	8	9	Nil	ET	Grand Total
BSK	**2**	**4**	**112**	**4**	**71**	**76**	**26**	**3**	**4**	**1**	**2**	**305**
Deepwater Trawl	1	1							4	1	2	9
Hoki, Hake, Ling, Warehou Trawl		3	101	4	31	30	26	1				196
Inshore Trawl			8		2							10
Pelagic Trawl			1					2				3
Purse Seine	1											1
Scampi Trawl						4						4
Setnet (Rig/ School shark)			1									1
SLL					3							3
Southern blue whiting trawl						2						2
Squid Trawl			1		35	40						76
GGP	**1**			**1**								**2**
Hoki, Hake, Ling, Warehou Trawl				1								1
SLL	1											1
MJA	**104**								**4**		**4**	**112**
Purse Seine	99								3		4	106
SLL	5								1			6
ODO		**3**										**3**
Hoki, Hake, Ling, Warehou Trawl		1										1
Scampi Trawl		2										2
SBG	**4**	**1**							**1**			**6**
Deepwater Trawl									1			1
Setnet (Butterfish)	1											1
Setnet (other)	1	1										2
Setnet (Rig/ School shark)	2											2
WPS	**12**	**1**	**5**		**20**	**11**	**18**	**1**	**2**		**2**	**72**
Deepwater BLL	2											2
Hoki, Hake, Ling, Warehou Trawl			2		3		16					21
Inshore BLL (Snapper)			1		2							3
Inshore Trawl (Snapper)									1			1
Pelagic Trawl							1	1				2
Setnet (Elephant fish)					1							1
Setnet (other)	8	1	1		3						1	14
Setnet (Rig/ School shark)	1		1									2
SLL	1				1		1		1		1	5
Squid Trawl					10	11						21
Grand Total	**123**	**9**	**117**	**5**	**91**	**87**	**44**	**4**	**11**	**1**	**8**	**500**

Table 6. Aggregated protected fish interactions by fishery and FMA for the period 1999 to 2011 Taken from the merged data set of fisher and observer reports used in Francis and Lyon 2012.

Fishery Group	1	2	3	4	5	6	7	8	9	Nil	ET	Grand Total
Deepwater BLL	2											2
Deepwater Trawl	1	1							5	1	2	10
Hoki, Hake, Ling, Warehou Trawl		4	103	5	34	30	42	1				219
Inshore BLL (Snapper)			1		2							3
Inshore Trawl			8		2							10
Inshore Trawl (Snapper)									1			1
Pelagic Trawl			1				1	3				5
Purse Seine	100								3		4	107
Scampi Trawl		2				4						6
Setnet (Butterfish)	1											1
Setnet (Elephant fish)					1							1
Setnet (other)	9	2	1		3						1	16
Setnet (Rig/ School shark)	3		2									5
SLL	7				4		1		2		1	15
Southern blue whiting trawl						2						2
Squid Trawl			1		45	51						97
Grand Total	123	9	117	5	91	87	44	4	11	1	8	500

Table 7 CSP Research response over the next 5 years: SURV= Post release survival estimate; TRACK= Tracking Studies; BIO Biological Sampling of specimens; L1RA= inclusion into Level1 Risk Assessment; L2RA= Inclusion into Level 2 Risk Assessment; MIT= .Mitigation Research; LIVE= Live release research; GEN= Genetic analysis.

		Year				
Species	**Research**	**1**	**2**	**3**	**4**	**5**
Basking shark	L1RA					
	L2RA	■				
	MIT	■	■			
	SURV		■	■		
	LIVE					
	TRACK		■	■		
	BIO	■	■	■	■	■
	GEN				■	■
Deepwater nurse shark	L1RA	■				
	L2RA		■			
	MIT					
	SURV					
	LIVE					
	TRACK					
	BIO	■	■	■	■	■
	GEN				■	■
Oceanic whitetip shark	L1RA	■				
	L2RA		■			
	MIT			■	■	
	SURV			■	■	
	LIVE			■	■	
	TRACK					
	BIO	■	■	■	■	■
	GEN				■	■
Whale shark	L1RA	■				
	L2RA			■		
	MIT					
	SURV					
	LIVE					
	TRACK					
	BIO	■	■	■	■	■
	GEN					
White pointer shark	L1RA					
	L2RA	■				
	MIT		■	■		
	SURV		■	■	■	
	LIVE		■	■	■	
	TRACK					
	BIO	■	■	■	■	■
	GEN				■	■
Manta ray	L1RA	■				
	L2RA			■		
	MIT					
	SURV					
	LIVE					
	TRACK					
	BIO	■	■	■	■	■
	GEN					
Spinetail devil ray	L1RA					
	L2RA	■				
	MIT	■				
	SURV	■	■			
	LIVE	■	■	■		
	TRACK		■	■		
	BIO	■	■	■	■	■
	GEN				■	■
Giant grouper	L1RA	■				
	L2RA			■		
	MIT					
	SURV					
	LIVE					
	TRACK					
	BIO	■	■	■	■	■
	GEN					
Spotted black grouper	L1RA	■				
	L2RA			■		
	MIT					
	SURV					
	LIVE					
	TRACK					
	BIO	■	■	■	■	■
	GEN					

Appendix 1 – Qualitative (Level 1) Risk Assessment of the impact of commercial fishing on New Zealand Chondrichthyans - Level 1 Protected species chapter

3.3 Protected species

Seven species of shark are afforded absolute protection under the Wildlife Act 1953[8] (Table 6). Spatial distribution is highly variable among these species, some occupying wide ranges, though at low densities, while others display more restricted distributions; a number of species are also known to be migratory. Susceptibility to interaction with commercial fisheries is dependent on the temporal and spatial distribution of these species in relation to fisheries as well as the species vulnerability to the gear used. For example, spinetail devil ray interactions are mainly with purse seine fisheries whereas basking and white shark interactions have been observed in a much broader range of fisheries, both demersal and pelagic, ranging from the North Island to the sub-Antarctic islands.

Table 6: Shark species protected under Schedule 7a of the Wildlife Act 1953 including IUCN threat status (these species have not yet been assessed against the revised New Zealand Threat Classification System 2008 therefore IUCN Redlist classifications are used).

Common name	Scientific Name	Family	IUCN Threat Ranking
Basking shark	*Cetorhinus maximus*	Cetorhinidae	Vulnerable
Smalltooth sandtiger shark	*Odontaspis ferox*	Odontaspididae	Vulnerable (decreasing population)
Oceanic whitetip shark	*Carcharhinus longimanus*	Carcharhinidae	Vulnerable
Whale shark	*Rhincodon typus*	Rhincodontidae	Vulnerable (decreasing population)
White shark	*Carcharodon carcharias*	Lamnidae	Vulnerable
Manta ray	*Manta birostris*	Mobulidae	Vulnerable
Spinetail devil ray	*Mobula japanica*	Mobulidae	Near Threatened

Shark species have been added to Schedule 7a of the Wildlife Act for a variety of reasons including their susceptibility to anthropogenic impacts and obligations under international agreements. Protection under the Wildlife Act means that the animals (alive or dead), and any part of them, cannot be intentionally harmed, held or traded. While incidental mortality of protected species occurs during the course of fishing, there are compulsory reporting requirements for fishers regarding incidental captures. The management intent is to minimise these incidental captures. Protected shark species fall within the mandate of the Conservation Services Programme (CSP) administered by the Department of Conservation. Through the CSP, DOC has an ability to levy commercial quota holders for relevant research to understand the nature and extent of interactions and techniques to mitigate them.

Under the CSP, research has been undertaken by Francis & Lyon (2012, 2014) to review the population and bycatch information for the nine protected fish (including sharks) species, while more in-depth work has been undertaken to look at changing bycatch rates of basking shark and the factors which may be affecting this (Francis & Sutton 2013). Research into the bycatch of spinetail devil rays has revealed that post-release survival is probably low and crew handling and release techniques can influence this survival (Jones & Francis 2012, Francis 2014). This work has led to recommendations for improvement of animal release in order to reduce fisheries impacts.

The overall risk for protected shark species, its component parts (intensity and consequence) and the confidence in these scores, in terms of both the amount and quality of the data and the extent of consensus amongst the panel, are displayed in Figure 8. Basking shark and spinetail devil ray attained

[8] Some of these species are also protected under the Fisheries Act 1996, see the NPOA-Sharks (2013) for details.

the highest risk scores, and the lowest possible scores were allocated to whale sharks, oceanic whitetip sharks and manta rays.

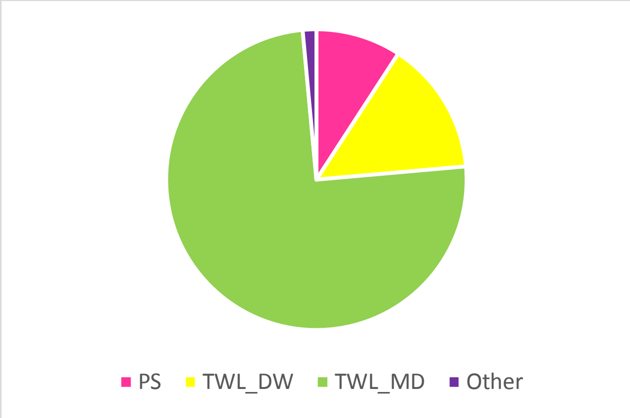
Scores for protected sharks showed lower risk scores than many QMS or non-QMS sharks. Intensity scores for protected sharks ranged from 3, described as “the amount of captures are moderate at broader spatial scale or high but local” to 1, described as “remote likelihood of catch/capture at any spatial or temporal scale”. Consequence scores ranged from 4.5 (undescribed in Table 3) which can be interpreted as a high likelihood of actual, or potential for, unsustainable impacts, to 1 which can be described as “impact unlikely to be detectable at any scale”. The minimal risk scores (1) seen for whale sharks, oceanic whitetip sharks and manta rays are on the basis that either no captures have ever been recorded of these species, or none in the last 5 years.

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	✓✓	✓✓

Figure 8: Protected Species Risk scores. For the COMPONENTS OF RISK higher numbers indicate greater intensity or consequence of impact (for more details see Table 2 and Table 3). 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.

Basking shark *Cetorhinus maximus*
(Intensity = 3, Consequence = 4.5, Risk = 13.5)
Estimated Total Commercial Catch (2008–09 to 2012–13 fishing years): 15 tonnes
Live bearer



Confidence

Data were described as ‘exist but poor’ as no ageing, reproductive frequency or abundance indices exist. Consensus was achieved, but with low confidence

Rationale

Basking shark was estimated as vulnerable to fishing across 45 to 60% of their range and caught between 1 and 100 days a year.

Basking shark is globally widespread (Ebert et al. 2013) but was classified as having a relatively small population in New Zealand waters. Basking shark is potentially a migrant in NZ waters but movement and connectivity information is lacking and high and localised catches can occur (Francis & Lyon 2012). Given their length (up to 10 m) and the small size of the only known litter (6 pups) this species is likely to have a low productivity (Francis & Duffy 2002). Fewer females have been caught in New Zealand than males (Francis & Smith 2010). Longer-term data show that catch rates were larger in the period 1986 to 1991, but the reason for the decline in catch rates is unknown (Francis & Sutton 2012).

Spinetail devil ray *Mobula japanica*
(Intensity = 3, Consequence = 4.5, Risk = 13.5)
Estimated Total Commercial Catch (2008–09 to 2012–13 fishing years): 6 tonnes
Live bearer

Confidence

Data were described as 'few' as no reproductive frequency or abundance indices exist. Consensus was achieved, but with low confidence due to the lack of data.

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Rationale

Spinetail devil ray was estimated as vulnerable to fishing across 31 to 45% of their range and caught between 100 and 200 days a year (the skipjack tuna fishery that catches them only operates over the warmer months and catches are highly variable year to year). Fish spotter plane pilots anecdotally suggest that the spinetail devil ray can be highly abundant in some years.

Spinetail devil ray is globally widespread (Couturier et al. 2012) and their population size was classified as moderate in New Zealand waters. Spinetail devil ray have very low fecundity taking on average 1 year to produce one juvenile, and they live to at least 14 years (Francis & Lyon 2012, Cuevas-Zimbrón et al. 2013). Spinetail devil ray mostly come down from the tropics/subtropics in January to March and are caught by purse-seiners (Francis & Lyon 2012) out to a depth of 500 m; but beyond 500 m depth we have no knowledge of their distribution. Some captured spinetail devil ray are pregnant (Francis & Lyon 2012), so this increases the consequence score.

Great white shark *Carcharodon carcharias*
(Intensity = 3, Consequence = 4.5, Risk = 13.5)
Estimated Total Commercial Catch (2008–09 to 2012–13 fishing years): 22 individuals
Live bearer
(No pie graph is shown here as less than 5 tonne of estimated catch was reported in the 2008–09 to 2012–13 fishing years – see Section 2.3 for more detail)

Rationale

Great white shark was estimated as vulnerable to fishing across 16 to 30% of their range and caught between 100 and 200 days a year. There is however a known absence of reporting of captures of juveniles in inshore fisheries (where they are found in summer-autumn). Larger individuals are likely to have low vulnerability to capture and very few mature females are observed in New Zealand (C. Duffy and M. Francis pers. comm.).

Great white shark are globally widespread (Ebert et al. 2013) but classified as having a relatively small population in New Zealand waters. Productivity is relatively low with females reproducing from 14 years old (Francis & Lyon 2012), although this is considered likely to be an underestimate (M. Francis pers. comm.) with a maximum known age of 70 (Hamady et al. 2014). On average 8 pups are produced at a time (Francis 1996). The great white shark population on the east coast of Australia is stable, and genetic evidence suggests that these sharks mix with the New Zealand population (Malcolm et al. 2001, Blower et al. 2012). There is little fishing elsewhere in the population's south-west Pacific range (M. Francis, pers. comm.) and inshore set-net bans (e.g. west coast North Island for marine mammal protection) are likely to help this species.

Confidence

Data were described as 'exist but poor' as the frequency of reproduction is unknown and no abundance indices exist. Consensus was achieved, but with low confidence.

Smalltooth sandtiger shark *Odontaspis ferox*

(Intensity = 4, Consequence = 2, Risk = 8)
Estimated Total Commercial Catch (2008–09 to 2012–13 fishing years): less than 1 tonne.
Live bearer
(No pie graph is shown here as less than 5 tonne of estimated catch was reported in the 2008–09 to 2012–13 fishing years – see Section 2.3 for more details.

Rationale

Smalltooth sandtiger shark was estimated as vulnerable to fishing across 1 to 15% of their range and caught between 100 and 200 days a year. This species aggregates on seamounts which makes them susceptible to fisheries that target seamounts.

Smalltooth sandtiger shark are globally widespread (Ebert et al. 2013) but classified as having a relatively small population in New Zealand waters. Productivity is not proven, but reproduction is likely to be the same as in the closely-related grey nurse shark (*Carcharias taurus*) which has a litter size of two (Francis & Lyon 2012). Smalltooth sandtiger shark has declined in Australia, potentially due to fisheries (Francis & Lyon 2012). The lack of fishing around the Kermadec Islands and within Benthic Protection Areas (Helson et al. 2010) is likely to provide some protection to this shark from fisheries.

Confidence

Data were described as 'few' as no ageing, reproductive frequency data, reliable ranges or abundance indices exist. In addition identification errors are likely and misidentifications are suspected from the data presented (as the species has not been reliably identified south of approximately the South Taranaki Bight). Consensus was achieved, but with low confidence due to the lack of data.

Whale shark *Rhincodon typus*
(Intensity = 1, Consequence = 1, Risk = 1)
Estimated Total Commercial Catch (2008–09 to 2012–13 fishing years): 0 individuals
Live bearer
(No pie graph is shown here as less than 5 tonne of estimated catch was reported in the 2008–09 to 2012–13 fishing years – see Section 2.3 for more detail)

Rationale

Whale shark was estimated as vulnerable to fishing across less than 1% of their range and caught less than one every few years (none were caught in the past five years). A single individual was caught off the Canterbury coast in the late 1970s (Francis & Lyon 2012). Whale sharks are highly migratory (Francis & Lyon 2012) but the provenance of those in New Zealand waters is unknown and are they believed to be at the edge of their range.

Whale shark are globally widespread (Ebert et al. 2013) but classified as having a relatively small population in New Zealand waters. Only one litter has been sized and this had over 300 embryos, which suggests high productivity (Francis & Lyon 2012).

Confidence

Data were described as ‘few’ as no ageing, reproductive frequency data or abundance indices exist. However, given the current low likelihood of catch consensus was achieved.

Oceanic whitetip shark *Carcharhinus longimanus*
(Intensity = 1, Consequence = 1, Risk = 1)
Estimated Total Commercial Catch (2008–09 to 2012–13 fishing years): 0 individuals
Live bearer
(No pie graph is shown here as less than 5 tonne of estimated catch was reported in the 2008–09 to 2012–13 fishing years – see Section 2.3 for more detail)

Rationale

Oceanic whitetip shark was estimated as vulnerable to fishing across less than 1% of their range and caught less than once every few years (none were caught in the past five years).

Oceanic whitetip shark is globally widespread (Ebert et al. 2013) but was classified as having a relatively small population in New Zealand waters. This species was classified as having a relatively low fecundity (average 6 pups per litter) and mature relatively early (females reproduce from 6 years old, with a maximum known age of 12 years; Francis & Lyon 2014). These sharks have a mainly tropical distribution and their populations are largely declining elsewhere (Francis & Lyon 2014).

Confidence

Data were described as ‘exist and sound’ for the purposes of the assessment and consensus was achieved.

Manta ray Manta birostris

(Intensity = 1, Consequence = 1, Risk = 1)
Estimated Total Commercial Catch (2008–09 to 2012–13 fishing years): 0 individuals
Live bearer
(No pie graph is shown here as less than 5 tonne of estimated catch was reported in the 2008–09 to 2012–13 fishing years – see Section 2.3 for more detail)

Rationale

Manta ray was estimated as vulnerable to fishing across less than 1% of their range and caught less than once every few years (none have ever been recorded caught in New Zealand). This species occurs off the north-east coast of North Island during summer-autumn (Duffy & Abbott 2003), and has not been observed in fisheries in New Zealand, which, if they were present, they would be expected to be vulnerable to.

Manta ray are globally widespread (Ebert et al. 2013) and classified as having a relatively large population in New Zealand waters. Manta rays have a litter size of 1 and maximum known age of greater than 20 years (Couturier et al. 2012). The distribution of the New Zealand population of Manta rays after they leave North Island waters is unknown.

Confidence

Data were described as 'exist but poor' as no age at maturity data exist, maximum known age is uncertain, as is reproductive frequency, and no abundance indices exist. Consensus was achieved (given the lack of captures).