

Papua New Guinea

National Plan of Action on Sharks and Rays 2021 – 2024

A National Policy for the Management and Conservation of Sharks in
Papua New Guinean Waters



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Cover photo: Dead sawfish and sharks which are bycatch from Jewfish fishing in Kikori, Gulf Province.
Photo credit: Yolarnie Amepou (PIKU Biodiversity Network).

Acknowledgements

This plan was produced by the National Fisheries Authority (NFA) and Conservation and Environment Protection Authority (CEPA) with support of the By-catch and Integrated Ecosystem Management (BIEM) Initiative being implemented by the Secretariat of the Pacific Regional Environment Programme (SPREP) under the Pacific-European Union Marine Partnership (PEUMP) programme funded by the European Union and the Government of Sweden. The work was led by the World Wide Fund for Nature Papua New Guinea (WWF), with technical assistance from Eco Custodian Advocates (ECA), University of Papua New Guinea (UPNG) and PIKU Biodiversity Network. Appreciation is extended to other government agencies, NGOs and private sector fishing companies in PNG, the Pacific Islands Forum Fisheries Agency (FFA), and those who contributed data to the formulation of this document.

This document further acknowledges fisheries officers from maritime provinces for their contributions in the three regional roadshows in Kavieng, Madang and Port Moresby.

Special thanks are extended to Vagi Rei of CEPA, Johnathan Booth of World Conservation Society (WCS) and David Mitchell of ECA for extensive comments on the manuscript.

In Memory of Kepslok Kumilgo of WWF-PNG.

This document has been prepared and printed with the financial support of the Pacific-European Union Marine Partnership (PEUMP) programme, funded by the European Union and the government of Sweden. Its contents do not necessarily reflect the views of the European Union or the Government of Sweden.

COMMENCEMENT DATE

By virtue of powers conferred upon the Minister responsible for Fisheries, under the PNG *Fisheries Management Act (1998) OR Fisheries Management (amendment) Act (2015)*, notice is hereby given that implementation of this National Plan of Action for Sharks will commence on the ...**2nd**... day of**June**...2021.

.....

Hon Lino Tom MP

Minister for Fisheries and Marine Resources



.....

Hon Wera Mori MP

**Minister for Environment, Conservation
and Climate Change**

FOREWORD

Papua New Guinea contains more than 7% of the world's biodiversity and is the last stronghold of Shark and Ray species in the world. A large range of these species are found in benthic habitats from the Bismarck and Coral Sea, to upstream freshwater rivers systems, such as the Kikori Delta in the Gulf of Papua and the Ramu River in the Madang Province.



Over the years, many global Shark and Ray populations have seen recent declines as they are under pressure from various threats such as the export of Shark fin and other parts for national income. They are also caught unintentionally as by-catch in tuna, prawn and coastal fisheries. This decline needs to be addressed as Sharks and Rays play an important role in the marine ecosystem as apex predators and some, such as the sawfish, are culturally significant to coastal communities.


CEPA is tasked under the mandate of the fourth goal of our Constitution, to conserve Papua New Guinea's natural resources and environment so that it can be used for the collective benefit of all, and replenished for future generations. As our country is also a signatory to the Convention on Biodiversity (CBD); the Government is committed to the development of national management strategies for vulnerable species that are also listed under the Convention of International Trade of Endangered Species (CITES).

The PNG Marine Program (2019-2022) through the Coral Triangle Initiative Threatened Species Working Group has initiated the process of drafting management conservation options specific to Threatened Species, starting with Sharks and Rays, with the intent to extend to other species of concern in the future. These efforts are also in line with other regional and global environmental agreements that the Papua New Guinea Government is a signatory to.

Therefore, the National Plan of Action for Conservation and Management of Sharks (NPOA) has been updated in response to a new Conservation Management Measure that was introduced by the Western and Central Pacific Fisheries Commission (WCPFC) in 2019. This NPOA aims to develop a consistent nationwide approach to Shark and Ray management and build sustainable marine resource management systems.

This has been updated with the assistance of the European Union and the Government of Sweden funded Pacific-European Union Marine Partnership (PEUMP) programme under its By-catch and Integrated Ecosystem Management (BIEM) Initiative implemented by the Secretariat of the Pacific Regional Environment Programme (SPREP). We express our thanks to the European Union, the Government of Sweden and WWF-PNG for their support and sincere efforts towards the existence of this National Plan of Action.

May it serve as a foundation towards conserving our Shark and Ray species for the generations to come.

A handwritten signature in blue ink, consisting of a large, stylized 'G' followed by several loops and a vertical line.

GUNTHER JOKU

Managing Director

PNG Conservation & Environment Protection Authority

Table of contents

<i>FOREWORD</i>	<i>i</i>
<i>Acronyms</i>	<i>iii</i>
1. Executive Summary	1
2. Introduction	2
2.1. Biology and the ecological and cultural importance of sharks and rays	2
2.2. Purpose of the NPOA	3
2.3. Scope	4
3. Review and reporting	4
4. Legal Context	5
5. Guiding Principles	7
6. Operational objectives	8
7. Status and description of sharks exploited in oceanic waters and in coastal artisanal and prawn trawl fishery	8
8. Description of PNG commercial fisheries that catch sharks	11
9. Management arrangements to minimise incidental shark mortality	12
9.1. Management Measures	12
9.2. Other Measures	14
10. Monitoring control and surveillance framework and enforcement	14
11. Data collection and analysis	14
12. Research	14
13. Capacity building	15
14. Implementation plan and schedule	15
15. Strategies, measures and actions to support NPOA-Sharks objectives	16
16. Logical Framework NPOA Sharks 2020	23
References	29

List of Tables

Table 1. List of sharks and rays in CITES Appendix 1 & 2	13
Table 2. Recommended list of Chondrichthyes for CITES Appendix 2	13

Acronyms

BRD	By-catch reduction device
CCRF	FAO code of conduct for responsible fisheries
CEPA	Conservation and Environment Protection Authority
CITES	Convention on International Trade in Endangered Species
CMS	Convention on migratory species
CMM	Conservation and management measure
COFI	Committee on Fisheries
CoP	Conference of parties
CPUE	Catch per unit effort
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DWFN	Distant Water Fishing Nation
EAFM	Ecosystem approach to fisheries management
ECA	Eco Custodian Advocates
EEZ	Exclusive Economic Zone
FAD	Fish aggregating device
FFA	Pacific Islands Forum Fisheries Agency
FAO	Food and Agriculture Organization
FMSY	Fishing mortality on maximum sustainable yield
GoP	Gulf of Papua
iFIMS	Integrated Fisheries Information Management System
IOM	Integrated oceans management
IPOA	International Plan of Action
IUCN Red list	International Union for Conservation of Nature's critical indicator of the world's species
IUU	Illegal, unreported and unregulated fishing
JCU	James Cook University
LBF	Locally based foreign
LMMA	Locally Managed Marine Area
MCS	Monitoring, Control and Surveillance
MSY	Maximum Sustainable Yield
NDF	Non-detriment findings
NFA	National Fisheries Authority
NOP	National Oceans Policy
NGO	Non-government organisation
NPOA-Sharks	National Plan of Action Sharks

NTFMDP	National Tuna Fisheries Management and Development Plan
OFP	Oceanic Fisheries Program
PEUMP	Pacific European Union Marine Partnership
PGK	Papua New Guinea kina
PNG	Papua New Guinea
RPOA-Sharks	Regional Plan of Action Sharks
SB _{MSY}	Spawning biomass producing maximum sustainable yield
SPC	The Pacific Community
TAC	Total allowable catch
TED	Turtle excluder device
TMDP	Tuna management and development plan
UNCLOS	United Nations Convention for the Law of the Sea
UPNG	University of Papua New Guinea
WCPO	Western and Central Pacific Ocean
WCPFC	Western and Central Pacific Fisheries Commission
WWF	World Wide Fund for Nature

1. Executive Summary

Sharks are vulnerable to overharvesting because they invest heavily in few offspring and have slow growth rates, late sexual maturity, low fecundity and long lifespans. As such, most shark species are vulnerable to overexploitation, with slow recovery rates once the population has been depleted.

The decision to develop a National Plan of Action on Sharks (*NPOA-Sharks*) for Papua New Guinea is a response to the requirement of managing the utilisation of sharks within its national waters in accordance with the Regional Plan of Action on Sharks (RPOA-Sharks). The *NPOA-Sharks* also fulfills management measures adopted by the Western and Central Pacific Fisheries Commission (WCPFC) and the broader objectives of the International Plan of Action for the Conservation and Management of Sharks (IOPA-Sharks).

This plan covers all species in the class Chondrichthyes which include sharks, skates, rays and chimeras that are affected directly and indirectly by fisheries within PNG's EEZ, coastal and territorial waters and freshwater estuarine ecosystems.

This *NPOA-Sharks* is for the next 4 years, with a review to take place every second year. It has been prepared in accordance with Section 28 of the Fisheries Management Act (1998) amended (2015) and also in accordance with the International (Fauna and Flora) Act 1979. These two acts are implemented by the National Fisheries Authority (NFA) and Conservation and Environment Protection Agency (CEPA) respectively.

NPOA-Sharks highlights different fisheries ventures in the country and how they have impacts on sharks and rays and it puts forward different management measures that PNG can undertake by both national and provincial governments to comply with regional and international expectations, so that individual species within the class Chondrichthyes do not face extinction.

2. Introduction

2.1. Biology and the ecological and cultural importance of sharks and rays

Papua New Guinea fisheries waters contain 132 known species of “shark” (including sharks, skates, rays and chimeras) (White *et al.*, 2017). Sharks have been valued for many reasons, including their unique characteristics, their important role as apex predators maintaining marine ecosystems health and their fishery components in commercial and artisanal fisheries which makes them vulnerable to exploitation. In particular, sharks in PNG are caught in the longline and purse seine fisheries that target tuna species as well as in the prawn trawl fishery in the Gulf of Papua (GoP). The typical life history characteristics of sharks is of very slow growth, late maturation, and production of few offspring which makes them vulnerable to overfishing with low rates of recovery. Such life-history characteristics indicate that sharks cannot be fished in the same manner as other pelagic species, such as tuna. Globally, an estimated 25% of all the shark and ray species are now at threat from extinction (Dulvy *et al.*, 2014), and the remaining species are now under threat due to the demand for shark fins, meat, liver oil, and other products (Kumoru, 2003). With no international catch limits for sharks, many local shark populations have been exploited to levels where local populations are greatly diminished. Base on observer data from sharks caught by shark longlines prior to the closure of this fishery in 2014; six out of eight longline vessels recorded a total biomass of 439 tonnes of sharks from a catch per unit effort (CPUE) of 42.5 sharks per thousand hooks of which silky shark (*Carcharhinus falciformis*) was the dominant species (White *et al.*, 2018) caught within PNG’s EEZ.

The tuna fishery in PNG is undertaken by both domestic flagged and foreign Distant Water Fishing Nation (DWFN) fleets through access agreements. Within the PNG Exclusive Economic Zone (EEZ) tuna is caught mostly by purse seine and longline. Most of this catch is Skipjack tuna (*Katsuwonus pelamis*) by purse seine fishing, but large amounts of Bigeye (*Thunnus obesus*) and Yellowfin (*Thunnus albacares*) are also landed, along with a significant quantity of shark by-catch¹.

Fishers in the maritime provinces of PNG also engage in artisanal shark finning where they extract fins from sharks and sell these as dried products to local buyers and exporters that are based in each province. Dive tourism for shark-watching and shark feeding is not fully developed, however there are a number of important sites that attract international tourists seasonally to see manta rays in various cleaning stations around the country.

Other seasonal activities that have interactions with sharks include inshore recreational fishing and chartered game fishing that occasionally take place in different parts of the country.

Sharks are revered in some PNG cultures with several coastal communities holding sharks as local totems and deities. In a world where most people view sharks with a mix of fear and loathing, PNG is one of the few places where many people embrace them. Within the villages of Tembin, Mesi, Kontu and Gawa, there are practicing shark-callers. Sharks have been an integral part of many traditional beliefs and culture.

¹ Detailed catch data is included in the Shark Assessment Report

The group skates and rays are another important group that make up elasmobranch, which comprises sharks, skates, rays and chimeras collectively. Skates and rays are made up of rays, sawfish, guitarfish, stingrays, butterfly ray, devil ray and the largest, manta ray. These all have the biological characteristics of being k-selected (*Stevens et al., 2000*) and share the same reproductive traits as sharks, investing in fewer offspring as a result of slow growth, low fecundity resulting in low rates of population increase. Rays are apex predators in the inshore environment and found circumglobally in tropical estuaries, tidal flats and mangrove swamps scouring for invertebrates, small vertebrates, crustaceans and fish. All known rays are carnivorous and as a group they are found high in the food web.

The coastal waters of PNG are currently known to have 51 species, across 30 genera and 17 families of rays (*White et al., 2017*). Many of these rays face the danger of local extinction through commercial fishing operations taking place in PNG's EEZ. In oceanic waters where tuna is harvested through longline and purse seine, manta ray and devil rays are at risk as they both feed by filtering in plankton near the surface over the continental shelf, increasing their chances of being caught in purse seine nets and on longline hooks. The prawn trawl fishing in the southern waters of PNG also presents a very high threat to rays. A study by CSIRO and NFA in the GoP prawn trawl fishery between June 2014 and August 2015 demonstrated that 71% of the elasmobranch caught as by-catch were sharks and 29% were rays and skates (*White et al., 2018*). Furthermore, the artisanal shark fin fishery in the coastal waters of GoP and in the estuaries of the Sepik River have a high rate of harvest for shark-like rays particularly sawfish, wedge fishes, guitarfish and shovel-nose rays.

A code-of-conduct for tourist operators must be developed and implemented, particularly for manta rays to avoid any harmful stress that divers might have on manta rays at any particular marine ecosystem. The code-of-conduct can be developed as a precautionary approach to avoid any unexpected ecological impacts that divers may have.

2.2. Purpose of the NPOA

To address global concerns about the management of sharks, the FAO organized experts to consult on an IPOA-Sharks. The IPOA-Sharks builds upon the FAO Code-of-Conduct for Responsible Fisheries and was endorsed by the FAO Council in June 1999, that was adopted by the November 1999 FAO Conference with an overarching goal of the IPOA-Sharks “to ensure the conservation and management of sharks and their long-term sustainable use.” To achieve this goal the IPOA-Sharks recommended that member states of the FAO that conduct fisheries which either target sharks, or regularly take sharks as incidental catch, should develop an *NPOA-Sharks*. In the Pacific the PI RPOA-Sharks is response to both the International Plan of Action (IPOA) for the conservation and management of sharks, which encourages assessments and management of shark fisheries, and to the Conservation and Management Measure (CMM) for Sharks adopted by the WCPFC.

Consistent with the *Fisheries Management Act* (1998) amended (2015) and the *International Trade (Fauna and Flora) Act* (1978), this Plan;

- (i) Ensures that there is conservation, management, and sustainable use of oceanic and coastal shark and ray resources in the waters of Papua New Guinea.
- (ii) Ensures coordination and control between NFA and CEPA in managing incidental shark and ray by-catch in the tuna longline, purse seine and the Gulf of Papua prawn trawl fisheries and measures to reduce by-catch are implemented as best practice by fishers within their licensing permits and conditions.
- (iii) Calls for NFA to consider management measures to regulate artisanal shark fishing for shark fin in the maritime provinces of PNG.

- (iv) Encourages coastal, maritime and riverine communities to set up LMMAs to protect and manage critical habitats such as breeding, feeding and cleaning stations used by sharks, rays, sawfish and chimaeras.

2.3. Scope

The scope of this plan;

- (i) Defines “sharks” as all species in the Class *Chondrichthyes*, which includes sharks, skates, rays and chimaeras;
- (ii) Covers pelagic, coastal and riverine ecosystems where sharks and rays are known to inhabit;
- (iii) Covers all licensed fishing vessels registered to fish whilst within PNG’s EEZ;
- (iv) Covers all maritime provinces where fishers participate in the artisanal fishing of sharks for shark fin;
- (v) Covers both commercial and artisanal fisheries which have direct and indirect impacts on shark and ray populations; and
- (vi) Covers recreational tourism and game fishing operators involved with sharks and rays.

3. Review and reporting

In the absence of a monitoring and evaluation plan, the *NPOA-Sharks* serves as a precautionary approach to the sustainable use and management of shark and ray species over next four years. By year two, a monitoring and evaluation plan will be consolidated to inform this plan and subsequent plans.

A review of the progress of this NPOA will be done in the second year, which will consider;

- (i) Latest decisions of the WCPFC and CITES specific to sharks and rays as appropriate;
- (ii) Specific measures taken in other relevant international and regional shark instruments to which PNG is a Party or a cooperating non-member; and
- (iii) Identify gaps and highlight specific areas of improvement and cost-effective strategic interventions, thereby increasing the plan’s effectiveness.

The NFA and CEPA will play important roles in scientific studies of non-detrimental findings (NDF) and in the management of exports for fauna that are on CITES Appendix I,II and III listings respectively. Reporting to regional and international conventions and parties will also be handled by each authority. NFA will continue its role in reporting to WCPFC to maintain consistency in;

- (i) PNG’s WCPFC Part I & 2 Reports, consistent with reporting requirements against CMM2010-07 paras. 2 & 4, CMM2011-04 para. 3, CMM2012-04 paras. 3 & 6; and
- (ii) PNG’s report to FAO COFI meetings relative to the implementation status of the IPOA and *NPOA-Sharks*.

4. Legal Context

This plan is prepared in accordance to Section 28 of the *Fisheries Management Act (1998)* amended (2015) and is consistent with the strategic policy directions under the revised National Tuna Fishery Management and Development Plan 2014. This plan will also be used in accordance with the *International (Fauna and Flora) Act (1979)* for the species of sharks and rays listed under the IUCN Red List of threatened species and CITES Appendix I, II and III.

Other relevant policies and acts that could also be used to implement the different aspects of shark conservation and management include the;

Conservation Areas (Amendment) Act (2014): Section 12, Subsection 1 of this Act allows the Minister to make a recommendation for an area to be declared as a conservation area on the basis that the area has a particular biological, topographical, geographical, historical, scientific or social significance. Section 12, Subsection 2 allows a person or group of persons from an area with high biological diversity to make a request to the Minister to make a recommendation for the area to be considered a conservation area.

Fauna Protection and Control (Amendments) Act (2014): Section 15 of the *Fauna Protection and Control (Amendment) Act (2014)* Subsections (a) and (b) allows for the Minister to declare an area a Wildlife Management Area based on request from owners of the land within the area to be declared and the consultation between the Minister and the Local-level Government.

Fisheries Management (Amendment) Act (2015): Section 25 of the *Fisheries Management (Amendment) Act (2015)* defines the fundamental objective of promoting long-term conservation, management, and sustainable use of the marine living resources of Papua New Guinea for its people. Section 28 of this Act allows for Fisheries Management Plans to be written for the management as a fishery where subsection 6 specifies any implementation of the fishery management plan will not take effect until it has been published in the National Gazette. The *National Tuna Fishery Management and Development Plan 2014* manages the country's commercial tuna longline and purse seine fishery. Section 14(1) of this TFMD plan highlights potential impacts the fishery can have on the environment through the exploitation of non-targeted pelagic species, including sharks, turtles, sea birds and marine mammals thus, Section 7 allows for the precautionary principal to be applied for sustainable management of sharks and other shark-like rays.

Organic Law on Provincial and Local-Level Governments (1995): This law has provisions for Provincial and Local-Level Governments to create and legislate their own laws within their province and respective local-level governments. Under Part 3, Division 3, Subdivision A, Section 42, Subsection 1 (l) is the provision for laws that deal directly with fishing and fisheries which can be created for the province. Section 44, subsection 1 (p) allows the local-level government to create laws on local environment. The issue of managing species from local extirpation through overfishing as well as damages to important habitats can be addressed by creating laws in the province at these two government levels.

Maritime Zones Act (2015): Incorporates into the law of Papua New Guinea provisions of the *United Nations Convention on the Law of the Sea*. Subsection 1 (a) describes the territorial seas of Papua New Guinea by which 12 nautical mile territorial waters is defined and subsection 1 (b) defines the 200 nautical mile Exclusive Economic Zone (EEZ). These are key areas which fisheries operations are taking place and subsequently defined in section 3.3. (ii) and (iii) of this *NPOA-Sharks*.

National Oceans Policy (2020): Chapter 2 of the national oceans policy (NOP) defines avenues that are available and has applications that could be utilised to implement different aspects of *NPOA-Sharks*. Section 2.6 highlights the need for understanding the integrated oceans management (IOM) from and ecosystem-based management in the structure, service and function that ecosystems support. Section 2.11 highlights marine protected areas (MPA) as important conservation and management tool that can support biodiversity conservation and species management.

The plan also draws on relevant international and regional instruments such as the FAO *International Plan of Action for Sharks* (FAO IPOA-Sharks), FAO Code of Practice for Responsible Fisheries, Regional Plan of Action (Sharks) and WCPFC conservation and management measures on sharks (CMM2010-07; CMM2011-04; CMM2012-04) and CITES enlisted shark and ray species.

5. Guiding Principles

Drawing from the FAO IPOA-Sharks (FAO, 1999) and relevant shark related instruments, the key guiding principles under this *NPOA-Sharks* in relation to sharks shall be;

Participation	Effective participation in shark management and contribute towards minimizing fishing mortality on shark species or stocks
Sustaining stocks	Management and conservation strategies should aim to keep total fishing mortality for each stock within sustainable levels as adopted by the WCPFC, and the application of the precautionary approach
Nutritional and socioeconomic considerations	Management and conservation objectives and strategies should recognize that in some low-income food-deficit communities in PNG, shark catches are a traditional and important source of food and/or income. Such catches should be managed on a sustainable basis to provide a continued source of food, and/or income to diverse communities in the country.
Cooperation and integration	Require for the fullest possible cooperation among government and non-government agencies and institutions, stakeholders of the fishing industry and local communities, and engagement pursuant to this plan, TMDP and broader regional and international technical guidelines and measures on sharks.
Political actions	Amendment or drafting of law as appropriate in the effective management of sharks including measures for the reduction of shark by-catch in the commercial fishery sector of PNG. This will be informed by sound science and where this is absent will follow the precautionary principle as further outlined in this plan.
Best available science on sharks	Applied research and surveys, as appropriate, which are responsible for informing the management including total allowable catch (TAC) by species and providing non-detrimental findings (NDF) particularly for threatened species caught as by-catch in tuna and prawn fisheries thus, address the need to strengthen and improve or restore a favourable conservation status of sharks listed in the WCPFC CMMs.
Ecosystem and precautionary principals	Measures given in the Plan should apply widely both an ecosystem and precautionary principal. Lack of scientific certainty should not be used as a reason for postponing measures to enhance the conservation of sharks in PNG's fisheries waters.
Monitoring and compliance	Promotes effective monitoring of fishing activities and ensures compliance to shark measures in this plan. All licensed fishing may establish by mutual consent verifiable reporting systems incl. logsheet and observer reports that include full reporting of shark related data and information pursuant to this <i>NPOA-Sharks</i> , TMDP and broader regional and international guidelines and measures on sharks

6. Operational objectives

Further to the primary purpose of the Plan outlined earlier, the following operational objectives are adapted from the FAO IPOA-Sharks (FAO, 1999), the RPOA and also draws on the WCPFC CMM (sharks) and revised appropriately for implementation in PNG's EEZ. On this basis, this *NPOA-Sharks* should aim to;

- (i) Ensure that shark catch from non-directed fisheries such as the tuna fishery are reduced to near zero by implementing by-catch mitigation measures consistent with best practice principles as defined by the WCPFC and industry initiatives;
- (ii) Minimize waste and discards from shark catches by requiring the retention of shark carcass on vessel from which fins are removed and encourage the full use of sharks caught;
- (iii) Facilitate improved identification and reporting for on vessel observers targeting species-specific biological information and monitoring of shark catches;
- (iv) Develop applied research, data collection, monitoring, and ensuring proper samples of sharks and rays collected are well recorded and curated at the National Fish Collection at UPNG for future reference;
- (v) Assess threats to shark populations, determine and protect critical habitats and migratory corridors and critical life stages of sharks;
- (vi) Identify and provide special attention, in particular to IUCN's Red List, CITES listed and locally identified endemic, vulnerable and threatened shark stocks;
- (vii) Improve or develop frameworks for establishing effective consultation involving all stakeholders in research, management and educational initiatives;
- (viii) Increasing public awareness of threats to sharks and their habitats, and enhance public participation in conservation activities; and
- (ix) Implement all technical measures of the WCPFC CMM2010-07 (Sharks)

7. Status and description of sharks exploited in oceanic waters and in coastal artisanal and prawn trawl fishery

The status of sharks in the Western Central Pacific Ocean (WCPO) is of growing concern, and has become an area of priority analysis for the SPC's Oceanic Fisheries Programme (OFP). Seven shark species which frequently interact with longline and purse seine fisheries are being studied under the WCPFC's Shark Research Plan².

Shark species account for the bulk of the by-catch in the tuna fishery. Some longline vessels use wire traces and shark lines to target sharks. In Papua New Guinea, the average catch estimates for the shark fishery and by-catch from tuna and Gulf of Papua prawn fishery amounted 4, 100 tonnes between 2010 and 2013 (*White et al., 2019*). Following the closure of the shark longline fishery in 2014, the annual catch figures fell to 1, 600 tonnes (*White et al., 2018*).

² the Plan and other useful information regarding sharks is available at <http://www.spc.int/oceanfish/en/ofpsection/sam/264-new-research-plan-provides-a-blueprint-for-addressing-shark-issues-in-the-western-and-central-pacific>

Oceanic whitetip shark (*Carcharhinus longimanus*) – spawning biomass, total biomass and recruitment have all exhibited a declining trend since 1995 (the first year of the assessment) across the Pacific Island region, and the current spawning biomass is estimated to be at 15% of spawning biomass of maximum sustainable yield (SB_{MSY}) and current fishing mortality is estimated to be more than six times greater than the fishing maximum sustainable yield (F_{MSY}). The key conclusions are that overfishing is occurring and the stock is in a heavily overfished state relative to MSY-based reference points (*Rice and Harley, 2012b*).

Silky shark (*Carcharhinus falciformis*) – Silky sharks are a low productivity species. The greatest impact on the stock is attributed to by-catch from the longline fishery in tropical and subtropical areas, however there are also significant impacts from the purse seine fishery in the lower latitudes which catches predominantly juvenile sharks. Silky sharks is now banned from any commercial exploitation in the country, but continues to be caught as by-catch in tuna fishing operations.

Blue shark (*Prionace glauca*) – Results from the 2014 stock assessment looking at fishing periods from 1994 to 2014 highlighted difficulties in determining the stock status relative to MSY-based reference points from available catch and effort data and based upon necessary assumptions of blue shark biology characteristics. As such, the assessment is viewed as a work-in-progress.

Mako sharks (*Isurus* spp.) - Are among the least productive of all pelagic sharks, but are occasionally targeted for their food value. WCPFC scientists have suggested further research and/or data improvement to identify and clarify population status and trends for these species (*Molony, 2005*).

Thresher sharks (*Alopias* spp.) - Are also among the least productive of all pelagic sharks; again, WCPFC scientists have suggested further research and/or data improvement to identify and clarify population status trends for these species.

Whale shark (*Rhincodon typus*) – It is estimated that 75 whale sharks were killed in the Western and Central Pacific Ocean as a result of interactions with the region's purse seine fishery in the two years, 2009 and 2010 (*Rice and Harley, 2012a*). A ban on whale shark setting by licenced purse-seine fishing vessels anywhere in the Pacific was adopted by the Pacific Island States that are parties to the Nauru Agreement in 2010, and this ban was later extended to the entire western and central Pacific Ocean purse-seine fleet by WCPFC (*Clarke, 2018*).

Hammerhead sharks (*Sphyrna* spp.) – Widely distributed in latitudinal range and appears to prefer tropical warm waters, and is largely concentrated along continental shelves and coastlines, but can be found in the deep ocean. Hammerhead shark particularly the Scalloped hammerhead shark (*Sphyrna lewini*) is a delicacy in many countries and is at a high risk of extinction. Little data exists on the by-catch of hammerhead sharks in the WCPO and thus no formal assessment has done on the stock for consideration by the WCPFC Scientific Committee. Preliminary results from genetic analysis of stock indicate that the Scalloped Hammerhead shark stock for Papua New Guinea is shared with that of Australia and Indonesia (*Chin et al., 2017*). This is similar to the Silvertip shark and the Grey reef shark therefore the management of these species requires cooperation between these countries.

Guitarfishes (*Glaucostegus* spp.) Found in very shallow bays, mangrove swamp and estuaries including brackish water; also offshore on the continental shelf (*White et al., 2017*). Guitarfish are common in the by-catch of the Gulf of Papua prawn trawl fishery and in coastal fisheries in the provinces of Western, Gulf, Milne Bay and East Sepik. Meat is used

for human consumption, and dried fins sold to local buyers and subsequently exported (*White et al. 2017*).

Sawfishes (*Pristis spp.*). The Largetooth sawfish (*Pristis pristis*) occurs in coastal marine habitats, estuaries and freshwater rivers, lakes and floodplains. Their juveniles spend time in upstream freshwater until close to maturation (*White et al., 2017*), when they then migrate to coastal estuarine areas. The Dwarf sawfish (*Pristis clavata*) and the Green sawfish (*Pristis zijsron*) are found mainly in inshore and estuaries. All sawfish's meat is utilised as food while their fins are dried and sold to local buyers (*White et al., 2017*). Their rostra are often either sold as a curio or kept as souvenirs by locals.

Manta Ray (*Mobula spp.*). Two species of manta rays are caught as by-catch in tuna and prawn trawl fisheries. The Reef manta (*Mobula alfredi*) is pelagic and occurs mainly in inshore areas around coral and rocky reefs, usually where there are upwellings. The Giant manta (*Mobula birostris*) is the largest of the two species is also found in coastal inshore areas and also in offshore islands and offshore seamounts (*White et al., 2017*). Both species feed exclusively on planktonic organisms and small bony fishes (*White et al., 2017*).

Devil Ray (*Mobula spp.*). There are a number of devil ray species which are endangered and are listed under CITES Appendix II. Many mobula rays are pelagic species occurring both inshore and well offshore (*White et al., 2017*). Many devil rays are caught as by-catch on purse seine nets and prawn trawl nets in the respective fishing operations.

8. Description of PNG commercial fisheries that catch sharks

The tuna fishery in PNG represents a balance of both domestic industry development and foreign distant water fishing nations (DWFN) access agreements. The fishery is guided by the National Tuna Fishery Management and Development Plan (NTFMDP) which establishes an overall management structure, and an application framework for all tuna fisheries. This include licence limits, catch and effort controls, gear restrictions, the use of fish aggregating devices (FADs), and other management tools for the purpose of tuna resource conservation and management as well as combating illegal, unregulated and unreported fishing activities (IUU).

PNG manages a purse seine fleet made up of two categories: (i) Domestic PNG flagged vessels and (ii) locally-based foreign (LBF) vessels. LBF vessels are foreign flagged with activities governed under charter arrangements with locally based companies. The target catches by tuna longline vessels in PNG waters are dominated by Yellowfin tuna (*Thunnus albacares*) with an annual average of 877 tonnes caught between 2013 and 2017, followed by Albacore (*Thunnus alalunga*) 199 tonnes and Bigeye (*Thunnus obesus*) 59 tonnes. Sharks have been caught in large numbers with a combined average of 67 tonnes. Prior to the closure of the fishery in July 2014, the shark longline fishery was managed under a separate management plan from the tuna long line fishery, with a limit of 9 vessels, a setting rate of 1,200 hooks per day, and a total allowable catch of 2,000 tonnes dressed weight per year (Kumoru, 2009).

PNG is the only country in the Pacific with a demersal prawn trawl fishery. Despite its limited capability it is one of the most valuable export fisheries for PNG, earning revenue of Papua New Guinea kina (PGK) 10 million. The GoP prawn fishery is 100% PNG owned and operates from the south coast of PNG from the mouth of the Fly River in the west to the Iloke coast in the east. The fishery targets Banana prawns (*Peneaus merguensis*), Indian white prawns (*Peneaus indicus*), Giant tiger prawns (*Peneaus monodon*) and Green tiger prawns (*Peneaus semisulcatus*).

All commercial fishing operations have direct impact on the population of sharks and rays in the oceanic and coastal waters of PNG. Observer data from the tuna fishery indicate that 36% of the sharks caught as by-catch were dead or dying when brought to the boat and about 70% of sharks were dead when discarded. There is no data for the GoP prawn fishery however a study by CSIRO, the NFA and James Cook University (JCU) in the Gulf of Papua between June 2014 and August 2015 found that 81% of sharks and rays caught as by-catch were recorded dead at capture, 15% were dying or moribund, and only 4% were alive. In the oceanic waters, Silky sharks (*Carcharhinus falsiformis*), Oceanic whitetip (*Carcharhinus longimanus*), Scallop hammerhead sharks (*Sphyrna lewini*), Blue sharks (*Prionace glauca*), Mako sharks (*Isurus spp*) and Thresher sharks (*Alopias spp*) were the dominant species while the by-catch at the GoP fishery recorded the Australian sharpnose sharks (*Rhizoprionodon taylori*), Coates sharks (*Carcharhinus coatesi*), Australian butterfly rays (*Gymnura australis*) and Scallop hammerhead sharks (*S. lewini*).

9. Management arrangements to minimise incidental shark mortality

The strategic management framework on sharks draws on the FAO Technical Guidelines on the Conservation and Management of Sharks (FAO, 1999), RPOA-Sharks, and the CMM2010-07, CMM2011-04, CMM2012-04, CMM2013-08 and CMM 2014-05. Under this Plan, the management arrangements for achieving the above objectives outline in earlier sections include;

9.1. Management Measures

- (i) Ensure all fishing vessels catching shark are licenced to operate in the entire PNG EEZ and archipelagic waters;
- (ii) Regulate or manage the harvesting of sharks in PNG's waters using the following combination of measures:
 - *Ban shark targeted fishing by all commercial vessels fishing in all PNG waters (implemented in April 2014)*
 - *Ban finning unless all fins from the shark or ray are attached to the shark carcass either naturally or by permitted artificial means (CMM2010-07)*
 - *Ban the use of wire leaders and traces as branchlines on all longline vessels operating in PNG waters (CMM 2014-05)*
 - *Ban purse seine sets on whale sharks in accordance with CMM2011-04*
 - *Prohibition of retention, transshipping, storing on a fishing vessel, or landing in whole or in part, of any Oceanic whitetip shark or Silky shark (CMM2011-04, CMM2013-08)*
 - *Promotion of live release in a manner that results in as little harm to the shark as possible in accordance with CMM2013-08*
 - *Ban setting on a school of tuna associated with a Whale shark if the animal is sighted prior to the commencement of the set (CMM2012-04)*
 - *Encourage deeper hook deployment during longline fishing*
 - *Develop a mitigation plan to reduce purse seine interactions with whale sharks*
- (iii) Encourage the use of safe handling guidelines for sharks along with de-hookers and line cutters by assisting with making these available to the fishing operators.
- (iv) Consider spatial and temporal area closures for known nursery areas or pupping grounds.
- (v) Effective control and management of UNCLOS Annex 1, WCPFC key shark species, and CITES Appendix II listed shark species, through close monitoring of catches and ensuring compliance with specific measures and limits in this Plan:

UNCLOS Annex 1: Bluntnose sixgill (*Hexanchus griseus*), Basking shark (*Cetorhinus maximus*), thresher (Family Alopiidae, 3-species), Whale shark (*Rhincodon typus*), requiem sharks (Family Carcharhinidae, 52 species), hammerheads (Family Sphynidae, 9 species) and lamnids (Family Isuridae, 5 species) – in total, 72 species);

WCPFC key shark species - Porbeagle (*Lamna nasus*), Winghead hammerhead (*Eusphyra blochii*), Great hammerhead (*Sphyrna mokarran*), Scalloped

hammerhead (*S. lewini*) and Smooth hammerhead (*S. zygaena*); Blue (*Prionace glauca*), Silky (*Carcharhinus falsiformis*), Oceanic whitetip (*C. longimanus*), Shortfin mako (*Isurus oxyrinchus*), Longfin mako (*I. paucus*), Bigeye thresher (*Alopias superciliosus*), Common thresher (*A. vulpinus*) and Pelagic thresher (*A. pelagicus*), Whale shark (*Rhincodon typus*).

Table 1. List of sharks and rays in CITES Appendix I & II

Scientific Name	Common Name	CITES APPENDIX	YEAR	Recorded in PNG waters
SHARKS				
<i>Cetorhinus maximus</i>	Basking shark	II	2000	
<i>Rhincodon typus</i>	Whale shark	II	2003	Yes
<i>Carcharodon carcharias</i>	Great white shark	II	2005	
<i>Carcharhinus longimanus</i>	Whitetip sharks, silvertip sharks	II	2013	Yes
<i>Sphyrna lewini</i>	Scalloped hammerhead shark	II	2013	Yes
<i>Sphyrna mokarran</i>	Great hammerhead shark	II	2013	Yes
<i>Sphyrna zygaena</i>	Smooth hammerhead shark	II	2013	Yes
<i>Lamna nasus</i>	Porbeagle shark	II	2013	
<i>Carcharhinus falciformis</i>	Silky shark	II	2017	Yes
<i>Alopias pelagicus</i>	Pelagic thresher shark	II	2017	
<i>Alopias superciliosus</i>	Bigeye thresher shark	II	2017	
<i>Alopias vulpinus</i>	Common thresher shark	II	2017	
SKATES & RAYS				
<i>Mobula alfredi</i>	Reef manta ray	II	2017	Yes
<i>Mobula birostris</i>	Giant manta ray	II	2017	Yes
<i>Mobula eregoodootenkee</i>	Pigmy devil ray		2017	Yes
<i>Mobula hyperstoma</i>	Lesser devil ray	II	2017	
<i>Mobula japonica</i>	Spinetail mobula	II	2017	
<i>Mobula kuhlii</i>	Shortfin devil ray	II	2017	Yes
<i>Mobula mobula</i>	Devil fish	II	2017	Yes
<i>Mobula munkiana</i>	Munk's devil ray	II	2017	
<i>Mobula rochebrunei</i>	Lesser Guinean devil ray	II	2017	
<i>Mobula tarapacana</i>	Sicklefin devil ray	II	2017	Yes
<i>Mobula thurstoni</i>	Bentfin devil ray	II	2017	
<i>Anoxypristis cuspidata</i>	Narrow sawfish	I	2007	Yes
<i>Pristis clavata</i>	Dwarf sawfish	I	2007	Yes
<i>Pristis pristis</i>	Largetooth sawfish	I	2007	Yes
<i>Pristis zijsron</i>	Green sawfish	I	2007	Yes

In the 18th Conference of Parties to CITES (CoP 18) in August 2019 the following were recommended for CITES Appendix II listing

Table 2. Recommended list of Chondrichthyes for CITES Appendix II

Scientific Name	Common Name	IUCN Red List	Recorded in PNG waters
SHARKS			
<i>Isurus oxyrinchus</i>	Shortfin Mako shark	Endangered	
GUITARFISH			
<i>Glaucostegus typus</i>	Giant guitarfish	Critically Endangered	Yes
WEDGEFISH			
<i>Rhina ancylostoma</i>	Shark ray	Critically Endangered	Yes
<i>Rhynchobatus australiae</i>	Bottlenose wedgefish	Critically Endangered	Yes
<i>Rhynchbatus palpebratus</i>	Eye-brow wedgefish	Critically Endangered	Yes

9.2. Other Measures

- (i) Facilitate the utilisation of dead sharks;
- (ii) Implement elements of the WCPFC CMM 2010-07, CMM2011-04 and CMM2012-04, CMM2013-08 and CMM 2014-05: discourage waste and discards, encourage live release, prohibit finning (i.e. cutting of a shark fins and discarding its carcass at sea); and
- (iii) Prepare and submit a report on the progress of the assessment, development and implementation of *NPOA-Sharks* as part of its FD Annual Report, WCPFC Scientific Committee Part 1 Annual Report, and the biennial reporting to FAO on the Code of Conduct for Responsible Fisheries.

10. Monitoring control and surveillance framework and enforcement

- (i) Improve MCS and enforcement activities for the collection, processing, storage and marketing of sharks and shark-related products in the catching and processing sub-sectors;
- (ii) Establish a position for a dedicated fisheries officer (by-catch) within NFA responsible for all by-catch species including sharks;
- (iii) Promote practical and enforceable measures including those provided for under this Plan (e.g. technical, operational and management) within PNG's longline fishery.

11. Data collection and analysis

- (i) Improve and strengthen data collection and monitoring of shark data including logsheets, port sampling and observer reports;
- (ii) Redistribute observer effort so that more observers are deployed on vessels fishing for tuna in the southern areas of the PNG EEZ;
- (iii) Facilitate the collection and provision of shark landing data from all PNG fishing vessels and licensed foreign vessels active in the PNG EEZ and, PNG flagged vessels active elsewhere in the WCPO;
- (iv) Create and maintain species-specific national records of shark catches, landings and discards and obtain utilisation and trade data on shark species; and
- (v) Facilitate the timely access to and exchange of information necessary to coordinate conservation and management measures, and facilitate training in data quality.

12. Research

- (i) Collaborate and assist in the implementation of the WCPFC Shark Research Plan;
- (ii) Facilitate and encourage research on shark species;
- (iii) Promote and coordinate stock assessments and research in collaboration with appropriate management and scientific bodies to estimate potential for a shark fishery and options in setting future limits; and
- (iv) Undertake where possible, and encourage post release mortality research on sharks and rays.

13. Capacity building

- (i) Build and strengthen overall capacity in research, data collection, monitoring, compliance and enforcement;
- (ii) Use shark identification guides to train and raise awareness amongst stakeholders, particularly observers, crews, skippers and boat operators. Inform fishing masters on methods that minimise shark interactions;
- (iii) Regular awareness programmes including; internet posts, radio broadcasts, newspaper articles, posters, school talks and seminars, targeting schools and communities, associations and general fisheries outreach programs;
- (iv) Seek assistance through OFP-SPC, WCPFC Secretariat, the FFA and others in the production of information and educational material in local languages; and
- (v) Cooperate with relevant agencies and institutions to facilitate their plan of work in relation to this Plan.

14. Implementation plan and schedule

This Plan does not have a dedicated budget for its implementation. The delivery of the actions identified in this plan depends on the resources available allocated within the budgets of CEPA and NFA. Supplementary funds for implementation of certain activities may be obtained from other sources, however it is unrealistic to expect that all the issues identified in this Plan will be fully addressed by the two parties over the life of the Plan.

The successful implementation of this Plan requires high level of coordination between CEPA and NFA, among relevant stakeholders and groups including fishermen's associations, boat operators, conservation and environmental agencies, recreational and game-fishing associations, and research and technical fisheries related institutions.

15. Strategies, measures and actions to support *NPOA-Sharks* objectives

Note that some strategies and actions contribute to achieving a number of objectives.

Objective	Supporting strategies	Actions and possible timelines	Threat
17(i) Establish a joint working team between NFA, CEPA and partners	<ul style="list-style-type: none"> Develop a core working team comprising Tuna Management Unit, GoP Prawn Fisheries Management Unit, National Observers Program within NFA and the Sustainable Ecosystems Program Wing of CEPA to be the NCC. 	<ul style="list-style-type: none"> NFA and CEPA to discuss and appoint NFA to take lead role in the implementation of <i>NPOA-Sharks</i>. NFA as the chair to plan and coordinate activities scheduled to be undertaken. 	DIRECT <ul style="list-style-type: none"> <i>NPOA-Sharks will not be effectively implemented if no working cooperation between NFA and CEPA.</i>
	<ul style="list-style-type: none"> Include important representatives from NGOs, CBOs, Fishing Industry, Universities, scientists and other relevant stakeholders to be part of working committee. 	<ul style="list-style-type: none"> Implement the <i>NPOA-Sharks</i> once endorsed by Government (on-going). NFA, CEPA and stakeholders to start exploring innovative ideas, technologies to be deployed on 3 commercial fishing operations (purse seine, longline and prawn trawl) to exclude by-catch. 	

Objective	Supporting strategies	Actions and possible timelines	Threat
17(ii) Ensure that shark catches from non-directed fisheries are minimised, by implementing by-catch mitigation measures and best handling techniques	<ul style="list-style-type: none"> Development of fisheries regulations and policies that support the implementation of the <i>NPOA Sharks</i>. 	<ul style="list-style-type: none"> Promote within the fishing industry the release of live sharks while still in the water (using the guidelines for the safe release of whale sharks and sharks) (ongoing) For domestic commercial and foreign longline fishing vessels, ban the use of wire trace as branchline material and shark lines (immediate) Introduce regulations that prohibit the export of shark products especially species listed under CITES Appendix III. 	INDIRECT <ul style="list-style-type: none"> <i>Discrepancies in fishing fleets and from the observer's data.</i>

	<ul style="list-style-type: none"> Develop management regimes that ensure non-target species interaction are mitigated. 	<ul style="list-style-type: none"> Conduct further research and trials into the use of shark deterrents such as chemical necromone especially in tuna purse seine and longline. Implement use of by-catch reduction devices (BRD) and turtle excluder device (TED) in all GoP prawn trawlers. 	<ul style="list-style-type: none"> <i>Stakeholders do not commit to funding research and trials, may be an expensive exercise to them.</i>
	<ul style="list-style-type: none"> Ensure compliance with ban on the use of wire trace as branchlines 	<ul style="list-style-type: none"> Random vessel inspections, logbook data comparisons and analysis of Observer reports (on-going) 	

Objective	Supporting strategies	Actions and possible timelines	Threat
17(iii) Retention of dead sharks	<ul style="list-style-type: none"> Develop management arrangements that minimise discarding dead sharks and promote its utilisation. Investigate and explore options for full utilisation of shark carcasses from by-catch. 	<ul style="list-style-type: none"> Undertake stakeholder consultation to develop trip limits where sharks that are dead when brought to the side of the vessel may be landed provided the fins and associated carcass are retained. Consult with industry on the state of domestic and export markets and potential future developments and direction (on-going). Develop consistent policies across government so that if new markets for sustainably caught sharks are discovered these can be accessed with minimum regulatory difficulty (over the life of the <i>NPOA-Sharks</i>). 	<p>DIRECT</p> <ul style="list-style-type: none"> <i>Retention of whole carcass of dead shark to indicate that sharks were not targeted for their fins.</i> <i>There is ongoing threat from continuous shark finning on longline vessels where there is no presence of national observers.</i>
17(iv) Facilitate improved identification and reporting of species-specific biological and trade data, and monitoring of shark	<ul style="list-style-type: none"> Introduce full time observer program with the Gulf of Papua prawn fishery, have observers stationed on boat in all trawl operations. More observer training on identification of sharks and rays in the GoP Fishery. Assist with the development and use of 	<ul style="list-style-type: none"> Produce fishery specific by-catch ID sheets, posters for purse seine, longline and coastal prawn trawl operations. Assist FFA and SPC in trialling new electronic methods of monitoring, sampling and data collection that can be applied to sharks. 	<p>INDIRECT</p> <ul style="list-style-type: none"> <i>Incorrect information on shark species particularly from the Gulf of Papua Prawn Trawl Fishery.</i>

catches	innovative ways of monitoring including on-board cameras and remote video.		
	<ul style="list-style-type: none"> Improve all aspects of shark data collection and monitoring for both offshore and inshore fisheries. 	<ul style="list-style-type: none"> Ensure current offshore logbook reports data on discards and shark life status when discarded. 	
	<ul style="list-style-type: none"> Ensure data is collected from industry and provided to relevant agencies in a thorough and timely manner; collect data from artisanal and local fishery markets. 	<ul style="list-style-type: none"> Provide data to SPC when required and Part I and Part II reports to the Commission on an annual basis by due agreed dates (on-going). Undertake a review of how best to collect appropriate information on artisanal fishery interactions with sharks (commencing in 2021) Train and incorporate local community based programs to utilise local fishermen to collect data using krill and market survey on sharks especially by the artisanal shark fishing communities. 	
	<ul style="list-style-type: none"> Support full development of the fisheries information system iFIMS to enable input of all relevant shark data. 	<ul style="list-style-type: none"> Support iFIMS developers in future developments of the system and ensure staff from NFA and CEPA can attend training sessions (on-going). 	
	<ul style="list-style-type: none"> Develop and distribute taxonomic guides for identification of shark species to participants with involvement in shark fishing, research or other activities. 	<ul style="list-style-type: none"> NFA to take a lead role in creating the needed species identification guides, and make them available to fishermen, fish processors, exporters, surveillance officers, customs officers, at-sea observers, in-port samplers, and researchers (by July 2021). Ensure these taxonomic guides are available to the artisanal fishing sector, the dive community and general public at a reasonable cost. 	

Objective	Supporting strategies	Actions and possible timelines	Threat
17(v) Build research, data collection, monitoring, compliance and enforcement capacity	<ul style="list-style-type: none"> On-going development of national scientific research capacity (Gazetted). Licensing to be done collaboratively between NFA and provinces. Collect data on species and relevant training of shark and ray identification to be built in each maritime province's terms of reference (ToR) with NFA. 	<ul style="list-style-type: none"> Ensure appropriate NCC staff are available to attend training courses such as the annual SPC SAW and FFA MCSWG session. Seek additional funding for fisheries related research (ongoing). Support NGO research and conservation work. Simple database system to be created for the 14 maritime provincial fisheries divisions through NFA's assistance. 	DIRECT <ul style="list-style-type: none"> <i>Poor data and information on sharks and rays including no stock assessments surveys are contrary to good governance and the sound implementation of NPOA-Sharks.</i>
	<ul style="list-style-type: none"> Develop and implement appropriate research programs to assess management methods to reduce shark mortalities. 	<ul style="list-style-type: none"> Support research to assess alternative management measures such as gear modifications or line setting techniques. Collaborate with CSIRO/SPC/UPNG in exploring the options of developing semiochemical necromone deterrents using shark by-catch. 	
	<ul style="list-style-type: none"> Evaluation of traditional knowledge, complimenting scientific data. 	<ul style="list-style-type: none"> Evaluate how traditional knowledge can be used to complement scientific data on shark behavior. 	
	<ul style="list-style-type: none"> Annually review Observer resources to ensure appropriate observer coverage that at minimum is consistent with Regional and WCPFC requirements. Observers and port samplers to be trained and certified to FFA/SPC regional standard. 	<ul style="list-style-type: none"> Increase observer coverage to the regionally agreed minimum levels of 5% for longline vessels by the end of 2021 with increased emphasis on the southern sector of the longline fishery. Make appropriate staff available to attend training sessions and attachments with FFA/SPC (on-going) 	

Objective	Supporting strategies	Actions and possible timelines	Threat
17(vi) Assess threats to shark populations, determine and protect critical habitats and migratory corridors and critical life stages of sharks	<ul style="list-style-type: none"> Promote and support appropriate research on stock status and management arrangements for sharks in the WCPO. 	<ul style="list-style-type: none"> Support research institutes, wherever possible by providing shark samples or vessels as research platforms for tagging etc. (on-going). Cooperate with other WCPFC parties, academic institutions and communities to develop shark stock assessments and to assess shark populations. Undertake data analysis and assess the application of spatial and or temporal closures as a management tool for artisanal fisheries. 	INDIRECT <ul style="list-style-type: none"> <i>Lack of continued support from regional and international organisations such as WCPO which is important for PNG to be in tune with the region and the globe.</i>
	<ul style="list-style-type: none"> Initiate appropriate reductions in fishing mortality where stock assessments indicate a particular species' biomass is assessed as being below either the target biomass once these have been established. 	<ul style="list-style-type: none"> This action should be decided and coordinated through SPC stock assessment processes and then implemented through FFA regional agreements or National regulations at the individual country level (ongoing). Undertake where possible, and encourage post release mortality research on sharks and rays. 	<ul style="list-style-type: none"> <i>PNG lacks a stock assessment or a species biomass in the next 4 years No information available in the review of NPOA-Sharks for the next 4 years.</i>
	<ul style="list-style-type: none"> Promote and support ongoing work by SPC/FFA and the WCPFC for better harvest strategies for key species in the WCPO. 	<ul style="list-style-type: none"> Through FFA and SPC, assist with the development of reference points or conceptual criteria for the management of shark by-catch by species and set target and limit reference points for each species as management objectives (Ongoing at WCPFC Science Committee meetings) 	
	<ul style="list-style-type: none"> Develop a monitoring and evaluation plan for evaluating the progress and effectiveness of <i>NPOA-Sharks</i>. Adopt a precautionary approach in the absence of scientific data when assessing new fisheries or fishery gear developments. 	<ul style="list-style-type: none"> M&E document to be completed by 2022 to be used to review the progress of <i>NPOA-Sharks</i>. Develop a policy on how to assess new fisheries or fishery gear in relation to ecosystem impacts, potential impacts on by-catch and the target stock and current fisheries by the end of 2023 	

Objective	Supporting strategies	Actions and possible timelines	Threat
17(vii) Implement all measures of the WCPFC CMMs and other arrangements on sharks and specific shark species	<ul style="list-style-type: none"> Implement new CMMs or regional arrangements relating to sharks. 	<ul style="list-style-type: none"> Implement applicable Commission CMMs relating to sharks in a timely manner. Implement and enforce the non-retention CMMs for Silky shark and Oceanic white tip sharks requiring fishers to not retain Oceanic whitetips whether dead or alive when retrieved on the longline or purse seine net. Implement regional arrangements for shark once these have been agreed (i.e. FFA Harmonised Minimum Terms and Conditions for Foreign Fishing Vessels). 	INDIRECT <ul style="list-style-type: none"> <i>Lack of compliance to regional commitments within which PNG has banned commercial Shark Fishing in July 2014 and NFA fails to meet other regional obligations</i>
	<ul style="list-style-type: none"> Ensure compliance with CITES Appendix II listing requirements for export products. 	<ul style="list-style-type: none"> Develop accreditation standards or management arrangements to ensure CITES Appendix II listed sharks can only be traded if they meet the requirements of an Appendix II listing. 	

Objective	Supporting strategies	Actions and possible timelines	Threat
17(viii) Improve or develop frameworks for establishing effective consultation involving all stakeholders in research, management and educational initiatives	<ul style="list-style-type: none"> NFA with assistance from FFA to develop an awareness programme that includes the supply of information, training and the supply of mitigation equipment such as line cutters and de-hookers to vessel operators and authorized officers. 	<ul style="list-style-type: none"> Conduct an annual awareness workshop for observers, MCS personnel and fishers including coverage of fishing license/authorization conditions, fishery plans, reporting, scientific data requirements, mitigation methods. Consider requiring vessel operators based in PNG to participate in an awareness workshop each year. Require foreign vessel's fishing agents to attend a workshop as a condition of access agreement prior to fishing in the PNG EEZ (annually). Investigate ways to provide line cutters and de-hookers to vessels that do not already have this equipment. 	INDIRECT <ul style="list-style-type: none"> <i>Lack of an arrangement between PNG and the region in receiving training.</i>

	<ul style="list-style-type: none"> • A MoU to be developed and signed between NFA, CEPA, Provincial Fisheries, Conservation NGOs, Research Institutions and other identified stakeholders to create a network to address and implement <i>NPOA-Sharks</i>. 	<ul style="list-style-type: none"> • Maritime provinces to review and incorporate the need for data handling and management training for provincial officers by NFA under their MoU with NFA. 	<ul style="list-style-type: none"> • <i>No MoU between the different partners that are important especially for information and data sharing between NFA, CEPA, NGOs and within each provincial fisheries division</i>
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Objective	Supporting strategies	Actions and possible timelines	Threat
17(ix) Increasing public awareness of threats to sharks and their habitats, and enhance public participation in conservation activities	<ul style="list-style-type: none"> • Develop a public education and awareness campaign that focuses on shark behaviour, habitat, interactions and management arrangements in the Territorial waters and the greater EEZ. 	<ul style="list-style-type: none"> • Modify and utilise existing NFA awareness programs to include information on shark interactions and management (other government agencies may have similar programs?). • Fund a short documentary film on the biology and importance of sharks ecologically and the need to stop population decline as by-catch and targets in the local artisanal shark fin fishery. • Ensure awareness materials of interest including those developed by FAO, SPC and other States are available to observers, the fishing and dive industries as well as schools and the general public. 	INDIRECT <ul style="list-style-type: none"> • <i>Lack of awareness to local communities targeting artisanal fisheries that is particularly important. Lack of awareness to Jew fish fishing for swim bladder is particularly important as many freshwater sharks and rays are also caught in nets and are also killed for their fins. This is important and needs to be addressed.</i>
	<ul style="list-style-type: none"> • Further develop NFA website and have a specific section relating to the <i>NPOA-Sharks</i> and shark management in general. 	<ul style="list-style-type: none"> • Develop the NFA website to allow the posting of information useful to stakeholders including latest shark research, catch and effort data and any useful information relating to sharks in the PNG EEZ (depending on IT workload). 	

16. Logical Framework *NPOA Sharks 2020*

GOAL: Shark and ray by-catch in tuna longline, purse seine and prawn trawl fishery and coastal and artisanal fishery within PNG EEZ is significantly reduced to a near zero if possible by 2024

Project Objective: Ensure major threats to sharks and ray population are minimized through strict management of incidental by-catch that results from Tuna and Prawn fisheries

OUTCOME	OUTPUT	ACTIVITIES	TIME FRAME	COMMENTS
1.0: NFA and CEPA have a clearly defined ToR specifying the roles they play in fulfilling commitments to WCPC and IPOA-Sharks.	1.1: Formation of an effective National Management Advisory Committee (NMAC) made up of a technical working group (TWG) which include, NGO, UPNG, Fishing Industry and other relevant stakeholders by 3rd quarter 2021, establish a NMAC comprising NGOs, UPNG, UNRAE, Fishing Industry and other relevant stakeholders.	<p>1.1.1: A first NMAC meeting chaired by NFA/CEPA (NFA even years, CEPA alternate odd years) to review the <i>NPOA Sharks</i> is conducted in 2022.</p> <p>1.1.2: Use the NMAC to review <i>NPOA-Sharks</i> after the second year.</p> <p>1.1.3: NFA, CEPA and NMAC to develop a Monitoring and Evaluation Plan for <i>NPOA</i>.</p> <p>1.1.4. <i>NPOA-Sharks</i> fully reviewed with amendments to make for years 3 and 4.</p>	2022	NMAC established first, then the committee will help progress other activities listed for the output.
2.0: Ensure that shark catches from non-directed fisheries are, minimal and therefore 'sustainable', by implementing by-catch mitigation.	2.1: Development of fisheries regulations and policies that support the implementation of <i>NPOA-Sharks</i> .	2.1.1: Promote within the fishing industry the release of live sharks while still in the water, including making available the guidelines for their safe release.	2020 ongoing	

		<p>2.1.2: Ban the use of wire trace as branch line material and shark lines.</p> <p>2.1.3: Introduce regulations that prohibit the export of shark products particularly for species listed in Appendix III.</p>	<p>Ongoing</p> <p>2022</p>	<p>M& document is important to be developed early. M&E provides the basis for assessment</p> <p>Changes identified can be useful</p>
	<p>2.2: Develop M&E plan outlining how outcome 2.0 can be evaluated.</p>	<p>2.2.1. M&E document to be written by NFA and CEPA and reviewed by NMAC by the end of 2022.</p>	<p>2020</p>	
	<p>2.3: Revisit current observer datasheet and make relevant amendments that will reflect the changes that are expected for improved data accuracy.</p>	<p>2.3.1: Review observer data and logbook for Tuna (purse seine & longline) and GoP prawn fishery.</p>	<p>2020 ongoing</p>	
		<p>2.3.2: Further review data/log book for artisanal shark fin fishery and make amendment to suit.</p>	<p>2020 ongoing</p>	
	<p>2.4: Develop management regimens that ensure non-target species are not overfished and at the same time minimize the risk of reducing industry profitability</p>	<p>2.4.1: NFA, CEPA and NMAC to recommend appropriate deterrents to be developed, tested and trialed in the tuna and prawn fishery in year 3rd and 4th year of the <i>NPOA-Sharks</i></p>	<p>October 2021</p>	
	<p>2.5: Review and make</p>		<p>2021</p>	

	amendments to the <i>International Trade (Fauna and Flora) Regulations</i> with emphasis on tougher penalties for violation and infringements of regulations.	2.5.1: Review species listed in CITES Appendix III		
3.0: Minimise waste from shark catch by requiring the retention of sharks when fins are removed and encourage full use of dead sharks	3.1: Develop a strategy that fully utilises shark by-catch	3.1.1: Marketing of shark carcass as well as opportunities to make fish meal from shark carcass is investigated	2023	
4.0: Improve Data accuracy on species identification and records on CUPE in Tuna (purse seine & longline) and GoP Prawn fisheries.	4.1: Targeted observer training on species identification particularly for sharks and rays in the GoP fishery that improves data quality	4.1.1: Review and upgrade of training on shark and ray species identification and data recording.	2020 ongoing	
		4.1.2: Certified training on species identification and data recording for observers and in tertiary fisheries courses	2022 ongoing	
		4.1.3: Observers equipped with Identification kit including a high-resolution water proof/inbuilt GPS camera to provide pictorial collection of by-catches	2021 ongoing	
	4.2: On-going development of national scientific research capacity that will inform improved management of sharks and rays	4.2.1: Continue to collaborate with CSIRO/ACIR/UPNG and NGOs in ensuring scientific studies are done in PNG waters to provide important information which can be used	Ongoing	

	<p>4.3: Review catch logbooks for Tuna and Prawn fishery and make necessary amendments that will provide accurate description of the by-catch and quantity.</p> <p>4.4: Support full development of the fisheries information system iFIMS to enable input of all relevant shark data</p> <p>4.5: An improved data recording system is developed to capture all required information to inform sustainable management of the artisanal shark fin fishery.</p>	<p>by <i>NPOA-Sharks</i></p> <p>4.3.1: Incorporate new information in logbook design that will help in species identification, data accuracy thus reducing flaws and other inconsistencies</p> <p>4.3.2: Provide accurate data and information to SPC when required with Part I and Part II reports to the Commission on an annual basis by the agreed dates (ongoing)</p> <p>4.4.1: A number of NFA staff are trained and equipped to be literate and proficient in the iFIMS system.</p> <p>4.5.1: Review of the current data collection and recording system for artisanal shark fin fishery with appropriate recommendations made for consideration by NFA/CEPA/NMAC</p>	<p>2022</p> <p>Ongoing</p> <p>2022</p>	
<p>5.0: Build, support research and data collection, monitoring, compliance and enforcement of sharks and rays found in freshwater and</p>	<p>5.1: CEPA and NFA research and stock assessment to inform the management of freshwater and coastal species.</p>	<p>5.1.1: Freshwater and Coastal species of sharks and rays population dynamics and distribution is documented Key threats highlighted and</p>	<p>2023</p>	

<p>coastal estuarine ecosystems that are often utilised by artisanal fishers in the shark fin fishery</p>	<p>5.2: CEPA to work closely with partner Environmental NGOs with data sharing agreements in order to collate data on distribution and abundance of sharks and rays</p>	<p>community action plans proposed.</p>	<p>2023</p>	
	<p>5.3: Through the partnership with NGOs assist local communities to work toward developing action plans to manage and conserve known breeding and feeding habitats for rays</p>	<p>5.2.1: Data on species diversity and abundance for freshwater sharks and rays are gathered and is used to make recommendations for species management</p>	<p>2022 ongoing</p>	
<p>6.0: Comply and implement all measures of the WCPFC CMMs and other arrangements on sharks and specific shark species.</p>	<p>6.1: Implement new CMMs or regional arrangements relating to sharks</p>	<p>6.1.1: Implement applicable commission CMMs relating to sharks in a timely manner</p>	<p>Ongoing</p>	
		<p>6.1.2: Implement and enforce the non-retention CMMs for Silky sharks (<i>Carcharhinus falciformis</i>) and Oceanic white</p>	<p>Ongoing</p>	

	<p>6.2: Ensure compliance with CITES Appendix II listing requirements for export products through strict management protocol enforcement.</p>	<p>tip sharks (<i>Carcharhinus longimanus</i>) requiring fishers to not retain oceanic whitetips whether dead or alive when retrieved on the longline or purse seine net</p> <p>6.1.3: Implement regional arrangements for sharks once these have been agreed (i.e. FFA Harmonized Minimum Terms and Conditions for Foreign Fishing Vessels</p> <p>6.2.1. Develop accreditation standards or management arrangements to ensure CITES Appendix II listed sharks can only be traded if they meet the requirements of an Appendix II listing.</p>	<p>Ongoing</p>	
<p>7.0: Improve or develop frameworks for establishing effective consultation involving all stakeholders in research, management and educational initiatives.</p>	<p>7.1: NFA with assistance from FFA to develop an awareness program that includes the supply of information, training and the supply of mitigation equipment such as line cutters and de-hookers to vessel operators and authorized officers</p>		<p>2022</p>	

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