National Plan of Action

for the Conservation and Management of Sharks

(NPOA-Sharks)

Foreword

South Africa's Exclusive Economic Zone is endowed with a rich variety of marine living resources. The sustainable management of these resources for the benefit of all South Africans, present and future, remains a firm commitment of the South African Government. South Africa is signatory to the Code of Conduct for Responsible Fisheries - voluntarily agreed to by members of the United Nations Food and Agriculture Organisation (FAO) - and, as such, is committed to the development and implementation of National Plans of Action (NPOAs) as adopted by the twenty-third session of the FAO Committee on Fisheries in February 1999 and endorsed by the FAO Council in June 1999.

NPOAs describe strategies through which commercial fishing nations can achieve economically and ecologically sustainable fisheries. South Africa published the NPOA-Seabirds – aimed at reducing incidental catch and promoting the conservation of seabirds in longline fisheries - in August 2008. South Africa has adopted an Ecosystem Approach to Fisheries and now regularly conducts Ecological Risk Assessments for all the commercial fishing sectors, widely consulting with all stakeholders regarding best management practices.

Acknowledging the importance of maintaining a healthy marine ecosystem and the possibility of major detrimental effects due to the disappearance of large predators, South Africa was the first country to offer full protection to the great white shark, removing it from the list of harvestable species. In accordance with international recommendations, South Africa subsequently banned the landing of a number of susceptible shark species, including oceanic whitetip, silky, thresher and hammerhead sharks.

South Africa implemented a ban on shark finning practices in 2004 and continually improves monitoring efforts for foreign vessels discharging shark products in its ports. To ensure long-term sustainability of valuable, but biologically limited, shark resources South Africa has already drastically reduced fishing effort in the demersal shark longline fishery and has terminated the pelagic shark longline fishery in favour of developing a more sustainable tuna and swordfish longline fishery.

The NPOA-Sharks presented here formalises and streamlines ongoing efforts to improve conservation and management of sharks caught in South African waters. The Fisheries Branch of the Department of Agriculture, Forestry and Fisheries has invested significantly in the area of shark research and capacity development including, but not limited to, the establishment of a dedicated shark research section at the Chief Directorate: Fisheries Research and Development, the formation of a Large Pelagic and Sharks Scientific Working Group and the commencement of research efforts dedicated to investigating the biology, ecology and stock status of commercially harvested shark species.

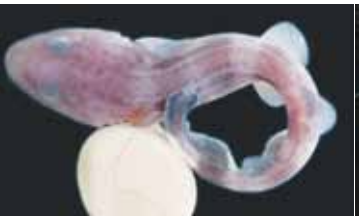
Situated at the boundary of the Atlantic and the Indian Ocean and two Large Marine Ecosystems (LMEs), the Agulhas and the Benguela LMEs, South Africa is destined to play a key role in ensuring the responsible harvesting of marine living resources associated with these systems, many of which are shared between many fishing nations, from Africa and beyond. The development of the NPOA-sharks is further testimony to the dedication of its Government to constantly improve mechanisms to ensure responsible management and long-term sustainable utilization of these resources for the benefit of all.

Ms Tina Joemat-Pettersson
Minister: Agriculture Forestry and Fisheries
Republic of South Africa





Table of Contents




Executive summary

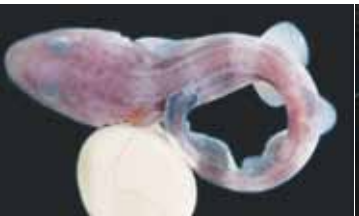
The global increase of shark catches raises concern about the sustainability of these resources. Sharks share life-history characteristics that make them susceptible to overexploitation. Not only are sharks often caught as by-catch in fisheries that are managed for species that can sustain a higher fishing pressure, sharks also form a large part of the unwanted by-catch that is discarded at sea, much of which is unrecorded and unregulated, which complicates the management of these resources. Taking cognisance of these concerns, the FAO committee on Fisheries held a number of expert meetings in 1998 and developed an International Plan of Action for Conservation and Management of Sharks (IPOA-Sharks). The guideline is to promote the conservation and management of sharks and their long term sustainable use, and is based on principles of the Code of Conduct for Responsible Fisheries, to which South Africa is a signatory. To achieve this goal the IPOA-Sharks recommended that member states of the FAO should develop a voluntary National Plan of Action for the Conservation and Management of Sharks (NPOA-Sharks). South Africa has one of the most diverse shark faunas in the world and many species are caught in appreciable quantities in directed and non-directed shark fisheries. South Africa has well developed fisheries management systems for most of its fisheries and many challenges with regard to the sustainable management and conservation of sharks have already been identified and addressed in individual fisheries policies and management measures. The South African National Plan of Action for sharks (NPOA-Sharks) provides information on the status of chondrichthyans in South Africa and examines structure, mechanisms and regulatory framework related to research, management, monitoring, and enforcement associated with shark fishing and trade of shark product in the South African context. This information is then used to identify, group and prioritize issues particular to the South African chondrichthyan resources that require intervention in the form of specific actions with associated responsibilities and time frames. Once adopted, this voluntary guideline will provide a mechanism for identifying and resolving the outstanding issues around management and conservation of sharks to ensure their optimal, long-term, sustainable use for the benefit of all South Africans.





Acronymns

CCAMLR:	Commission for the Conservation of Antarctic Marine Living Resources
CCSBT:	Commission for the Conservation of Southern Bluefin Tuna
COFI:	FAO Committee on Fisheries
DAFF:	Department of Agriculture, Forestry and Fisheries
EAF WG:	Ecosystem Approach to Fisheries Working Group
EEZ:	Exclusive Economic Zone
FAO:	Food and Agriculture Organisation
FRD:	Fisheries Research and Development
ICCAT:	International Commission for the Conservation of Atlantic Tunas
IOTC:	Indian Ocean Tuna Commission
IPOA-Sharks:	International Plan of Action for the Conservation and Management of Sharks
IUU Fishing:	Illegal, Unregulated and Unreported Fishing
MCS:	Monitoring, Compliance and Surveillance
MLRA:	Marine Living Resources Act
MLRF:	Marine Living Resources Fund
MRM:	Marine Resources Management
MSC:	Marine Stewardship Council
NPOA-Sharks:	National Plan of Action for Sharks
PEI:	Prince Edward Islands
RR:	Resources Research
SABS:	South African Bureau of Standards
SAR:	Shark Assessment Report
TAC:	Total Allowable Catch
TAE:	Total Allowable Effort
VMS:	Vessel Monitoring System
OMP:	Operational management Plan
ASPM:	Age Structured Production Model
SANBI:	South African National Biodiversity Institute
SAIAB:	South African Institute for Aquatic Biodiversity
MPA:	Marine Protected Area
PUCL:	Precautionary Upper Catch Limit
RFMO:	Regional Fisheries Management Organisation
KZNSB:	KwaZulu Natal Sharks Board
SASSI:	Southern African Sustainable Seafood Iniative




Glossary

ABUNDANCE: Degree of plentifulness for example the total number of fish in a population or a stock.

BIODIVERSITY: the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems. [Convention on Biological Diversity].

BIOMASS: or standing stock. The total weight of a group or stock of living organisms, or of some defined fraction of it, in an area at a particular time.

BY-CATCH: Part of a catch of a fishing unit taken incidentally in addition to the target species towards which fishing effort is directed. Catch may be retained or returned to the ocean as discards, usually dead or dying.

CATCH: The total number (or weight) of fish caught by fishing operations. Catch should include all fish killed by the act of fishing, not just those landed.

COLLAPSE: Reduction of a stock abundance by fishing and / or other causes to levels at which the production is negligible compared to historical levels.

CONSERVATION: Of natural resources. The act of maintaining, protecting or enhancing natural resources and ecosystems.

DEMERSAL: Living in close relation with the bottom and depending on it. Example: Cods, Groupers and lobsters are demersal resources. The term “demersal fish” usually refers to the living mode of the adult.

DIRECTED FISHERY: Fishing that is directed at a certain species or group of species. This applies to both sport fishing and commercial fishing.

DISCARD: To release or return fish to the sea, dead or alive, whether or not such fish are brought fully on board a fishing vessel.

ECOTOURISM: Travel undertaken to witness the unique natural or ecological quality of particular sites or regions, including the provision of services to facilitate such travel.

FINNING: The practice of removing fins and discarding the carcass, usually pertaining to sharks.

FISHING EFFORT: Measure of the amount of fishing.

HABITAT: means any area which contains suitable living conditions for a species.

HIGHLY MIGRATORY SPECIES OR STOCKS: Marine organisms whose life cycle includes large scale systematic movement patterns, usually through the EEZ of two or more countries as well as into international waters.

JOINT PRODUCT: Term used to describe the utilisation of by-catch species.

LONGLINE: A fishing gear in which short lines carrying hooks are attached to a longer main line at regular intervals. Longlines are either laid on the bottom or suspended horizontally at a predetermined depth with the help of surface floats.

MANAGEMENT: The art of taking measures affecting a resource and its exploitation with a view to achieving certain objectives, such as the maximization of the production of that resource. Management includes, for example, fishery regulations such as catch quotas or closed seasons.

MIGRATION: Systematic (as opposed to random) movement of individuals of a stock from one place to another, often related to season. A knowledge of the migration patterns helps in targeting high concentrations of fish and managing shared stocks.

MIGRATORY SPECIES: Organisms that move over national boundaries, and hence require international cooperation to enable their management.

NON-CONSUMPTIVE USE: Refers to cases where one person’s enjoyment does not prevent others from enjoying the same resource. For example, the viewing of marine mammals or other wildlife does not prevent another from enjoying the same resources.





OPTIMAL: Most favourable or desirable.

PELAGIC: Sharks that frequents surface waters or occur in the water column, not associated with the bottom but may make diurnal migrations between the surface and the ocean floor.

PRECAUTIONARY APPROACH: Is the ability to exercise prudent foresight to avoid unacceptable or undesirable situations, taking into account that changes in fisheries systems are only slowly reversible, difficult to control, not well understood, and subject to change in the environment and human values. The precautionary principle therefore promotes that measures be implemented to prevent degradation of the ecosystem where there are threats of serious or irreversible damage even in the absence of full scientific certainty.

RATIONAL USE: Decisions on resource utilization are derived from conclusions in a consistent way given the available information.

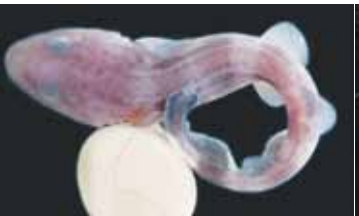
REQUIEM SHARKS: Any shark of the family Carcharhinidae, predominantly grey in appearance, live-bearing and migratory.

SHARKS: For the purpose of this document the term “sharks” is used to describe all chondricthyans (sharks, skates, chimeras and rays).

STAKEHOLDER: An entity (individuals or organizations) having a stake or interest in a physical resource, ecosystem service, institution, or social system, or someone who is or may be affected by a public policy.

STOCK: Fish stocks are subpopulations of a particular species of fish, for which intrinsic parameters (growth, recruitment, mortality and fishing mortality) are the only significant factors in determining population dynamics, while extrinsic factors (immigration and emigration) are considered to be insignificant.

SUSTAINABLE USE: Actions that maintain the long-term production of a renewable resource.




Introduction

There is international concern over the global increase of shark catches against a backdrop of scientifically monitored marked reductions in many shark populations. Sharks are particularly vulnerable to overexploitation due to closed stock-recruitment relationships, low biological productivity, and complex spatial structures. Sharks are often caught as by-catch in fisheries that are managed for species that can sustain a higher fishing pressure and sharks form part of the unwanted by-catch that is discarded at sea, much of which is unrecorded and unregulated. Fishing is therefore regarded as the single largest threat to many shark populations. Noting these concerns, the FAO Committee on Fisheries (COFI) developed in 1998 an International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks) within the framework of the Code of Conduct for Responsible Fisheries to which South Africa is a signatory. The IPOA-sharks is a voluntary instrument which encourages states to conduct a Shark Assessment Report (SAR) and adopt a National Plan of Action for Sharks (NPOA-sharks) if their vessels conduct shark-directed fishing or if their vessels regularly catch sharks in non-directed fisheries. For the purpose of this document the term "sharks" is used to describe all chondricthyans (sharks, skates, chimeras and rays). The objective of the IPOA-Sharks is to ensure the conservation and management of sharks and their long-term sustainable use, with the following specific aims:

i. Ensure that shark catches from directed and non-directed fisheries are sustainable;
ii. Assess threats to shark populations, determine and protect critical habitats and implement harvesting strategies consistent with the principles of biological sustainability and rational long-term economic use;
iii. Identify and provide special attention, in particular to vulnerable or threatened shark stocks;
iv. Improve and develop frameworks for establishing and coordinating effective consultation involving all stakeholders in research, management and educational initiatives within and between States;
v. Minimize unutilized by-catch of sharks;
vi. Contribute to the protection of biodiversity and ecosystem structure and function;
vii. Minimize waste and discards from shark catches in accordance with article 7.2.2.(g) of the Code of Conduct for Responsible Fisheries (for example, requiring the retention of sharks from which fins are removed);
viii. Encourage full use of dead sharks;
ix. Facilitate improved species-specific catch and landings data and monitoring of shark catches;
x. Facilitate the identification and reporting of species-specific biological and trade data.

The IPOA-Sharks requires each state to develop, implement and monitor its NPOA-Sharks. These plans were required to be submitted to COFI in 2001 and a progress report on implementation is required every two years.

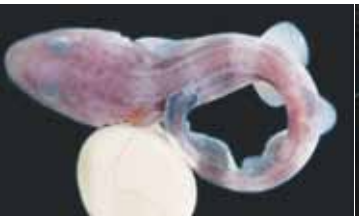
South Africa has a responsibility to develop a SAR and to adopt a NPOA-Sharks as good practice and consistent with its role as a signatory to the FAO Code of Conduct for Responsible Fisheries, it is Member Party of the International Commission for the Conservation of Atlantic Tunas (ICCAT), the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR), a Co-operating Non-Contracting Party of the Indian Ocean Tuna Commission (IOTC) and the Commission for the Conservation of Southern Bluefin Tunas (CCSBT). Moreover, South Africa has one of the most diverse faunas of cartilaginous fishes (Class Chondrichthyes) in the world, accounting for 181 species (15% of the world's shark species) (Appendix 1, Species Summary) of which 27.1% are endemic to Southern Africa (Appendix 1, Species Summary). Most species are poorly understood and constitute stocks of relatively low biomass (Appendix 1, Species Summary) However, a number of species are caught in appreciable quantities in directed and non-directed shark fisheries. Directed fisheries for sharks include the demersal shark longline, St Joseph (Elephantfish) net fishery, the traditional linefish fishery, recreational linefishery, and the Kwazulu Natal Bather Protection Program (Table 1, section 7). Important non-directed fisheries for retained shark include the tuna/swordfish longline fishery, and inshore/ offshore trawl.





The South African National Plan of Action for sharks (NPOA-Sharks) provides information on the status of chondrichthyans in South Africa as well as on structure, mechanisms and regulatory framework related to research, management, monitoring, and enforcement associated with shark fishing and trade of shark product in the South African context (The NPOA-sharks does not address issues pertaining to the non-consumptive utilization of sharks, such as shark diving and filming, which is currently being addressed in the Department of Environmental Affairs.). This information is contained in section 7 and provides the baseline for South Africa as required by the IPOA-Sharks in terms of a Shark Assessment Report.

This information is then used to identify, group and prioritize issues particular to the South African chondrichthyan resources that require intervention in the form of specific actions with associated responsibilities and time frames in order to attain the goals set out in the vision statement:




Vision

"The effective conservation and management of sharks that occur in the South African EEZ to ensure their optimal, long-term, sustainable use for the benefit of all South Africans, including both present and future generations."

The NPOA-Sharks recognizes the need to determine and implement harvesting strategies consistent with the principles of biological sustainability, attained through scientifically based management, and consistent with a Precautionary Approach. Furthermore, it strives to identify and direct attention, in particular, to vulnerable or threatened shark stocks, minimize by-catch capture of sharks and contribute to the protection of biodiversity and ecosystem structure and function.

The NPOA-Sharks recognizes the potential of non-consumptive use of sharks through ecotourism activities. These aspects of utilization need to be explored so as to find an optimum balance between consumptive and non-consumptive use, maximizing their benefits with low impact on the marine ecosystem.

Although the NPOA further recognizes that pollution, coastal development and climate change might negatively impact on sharks, the focus of the first NPOA-Sharks is fisheries related, including fisheries where sharks are caught as by-catch but not retained. The Plan is intended to have an initial implementation period of four years (2012-2015) with an annual review scheduled to determine progress. The final consultative review in year four would be used to provide the basis for a revision of the NPOA-Sharks, taking into account any new changes in fisheries.





Baseline information

Species information

The South African EEZ straddles two oceans and, if one considers the sub Antarctic Prince Edward Islands, includes all marine bio-zones, from tropical to polar. Consequently, South Africa has one of the most diverse faunas of cartilaginous fishes (Class Chondrichthyes) in the world. South African chondrichthyofauna include representatives from all 10 orders of cartilaginous fishes, 44 of the 60 families (73%), 100 out of 189 genera (53%), over 181 of the 1171 world species (15%) and 34 endemic species to southern Africa (27%) (Appendix 1) (Compagno 2000). This high level of diversity and endemism engenders South African responsibility in conserving and managing sharks that occur in South African waters and protecting those that enter South African waters periodically.

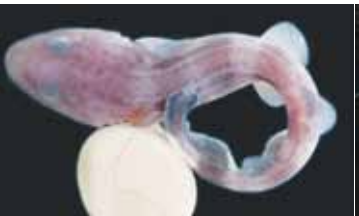
Management agencies and legislation

The Branch Fisheries Management, of the Department of Agriculture, Forestry and Fisheries is the lead governmental agency responsible for the management of sharks caught in South African fisheries. Fisheries Management is legally mandated to manage sharks in terms of the Marine Living Resources Act (MLRA), 1998 (Act No 18 of 1998) and the Regulations promulgated thereunder. Other additional acts that have relevance to the conservation of sharks include the National Environmental Management: Biodiversity Act, 2004 (Act No 10 of 2004), the National Environmental Management: Protected Areas Act, 2003 (Act No 57 of 2003), Dumping at Sea Control Act, 1980 (Act No 73 of 1980), and the KwaZulu-Natal Sharks Board Act, 2008 (Act 5 of 2008). Fisheries Management, in managing sharks, is supported by a number of agencies/ institutions, namely Oceans and Coast (Department of Environmental Affairs), South African National Biodiversity Institute (SANBI), KwaZulu-Natal Sharks Board, Ezemvelo KZN Wildlife, Oceanographic Research Institute, South African National Parks, Cape Nature, Bayworld, Iziko Museum of Natural History and the South African Institute for Aquatic Biodiversity (SAIAB).

Current management tools

Fisheries Management uses various management tools which have contributed to the conservation and sustainable fishing of many shark species. Some species due to their compromised conservation status have been afforded special protection status under the Regulations of the MLRA, e.g. the great white shark and the sawfish (Pristidae). In addition, spotted gully and raggedtooth sharks have been commercially delisted in terms of the Regulations of the MLRA (Appendix 2). Entry into any commercial fishery is limited by a rights allocation process, which is managed by Fisheries Management. The allocation takes into account scientific recommendations in limiting the number of vessels, crew and Total Allowable Catch (TAC) or Total Allowable Effort (TAE) for target species as well as precautionary catch limits for by-catch species. A number of coastal Marine Protected Areas (MPAs) have also been promulgated along the South African coastline with the aim of conserving biodiversity hot spots and providing harvest refuges for highly resident fishes. In so doing partial protection is afforded to some coastal shark species such as ragged tooth sharks, cow sharks, smooth hounds, cat sharks and juvenile requiem sharks. The impact of fisheries on some shark species has been reduced through permit conditions in certain fisheries e.g. tuna pole, which prohibit the landing of shark. Recreational bag limits have been reduced to one shark per fisher per day.

Hammer shark




Harvesting of sharks in south africa

The total South African shark catch is estimated at 6 562 t per annum (Appendix 3) and is derived from fisheries that can be divided into two principal components, that of directed and by-catch fisheries (Table 1). The first component represents fishing activities that target sharks –the demersal shark longline-, traditional line-, and St. Joseph shark net-fishery as well as the bather protection program and shark fishing for the aquarium trade. Sharks are also caught as both by-catch and as a targeted species in the large pelagic longline fishery and the recreational linefishery. For the purpose of this

Table 1. South African fisheries that have a shark component.

Fishery	Area	Main Shark Species	Target / By-catch
Demersal Shark Longline	West and South Coast	Smoothhound spp and soupfin sharks	Target
Large Pelagic Longline	Offshore to beyond EEZ	Blue and mako sharks	Target and By-catch
Bather Protection Program	East Coast	Large Carcharhinids species	Target
Traditional Linefish	Inshore to 200 m depth	Smoothhound spp and soupfin sharks	Target
St Joseph net	West Coast	St Joseph sharks	Target
Recreational Linefishery	Inshore to 200m depth	Large Carcharhinids	Target
Tuna Pole	Offshore to beyond EEZ	Blue and Mako sharks	By-catch
Hake Longline	West and South Coast to 500 m depth	Common smoothhound and soupfin sharks	By-catch
Inshore Trawl	South and East Coast to 200 m depth	Squalidae, Scyliorhinidae, smoothhounds spp, soupfin sharks, St Joseph and Rajids .	By-catch
Offshore Trawl	West Coast, Agulhas Bank to shelf edge (600 m depth)	Squaliform, Scyliorhinidae, soupfin sharks, Rajids and Chimeara.	By-catch
Prawn Trawl	KwaZulu-Natal East Coast to 600 m depth	Carcharhinid, Sphyrnid, Squalidae, Dasyatidae and Rajidae species	By-catch
Midwater trawl	South and East Coast	Pelagic sharks	By-catch
Gill net / Beach Seine (legal and illegal)	West, South & East Coast	Smoothhound spp, soupfin, St. Joseph sharks, and Rajidae.	Target and by-catch
Patagonian Tooth fishery	Prince Edward Islands	Deep water scyliorhinids, six gills, Rajidae	By-catch
Rocklobster trap		Scyliorhinid spp	By-catch
Aquarium trade		Small Carcharhinids and Scyliorhinidae	Target

document, the large pelagic longline and the recreational linefishery are also regarded as targeting sharks due to the relatively high shark catch that are retained in these fisheries. The second component is represented by fisheries that catch sharks as a component of their by-catch, e.g. hake longline, inshore trawl, offshore trawl, mid-water trawl/ purse seine fishery, and the beach seine ('treknet') fishery. Appreciable shark by-catches are also made in the tuna pole, prawn trawl, patagonian toothfish and in the rock lobster trap fisheries, but the animals are not necessarily retained. In the interest of clarity, profiles of fisheries that target sharks and those with appreciable by-catch are discussed separately.

Smoothhound sharks (*M. mustelus*) caught during National research demersal shark longline surveys aboard the research vessel *RV Ellen Khuzwayo* (Photo: Rob Tarr)

DIRECTED SHARK FISHERY PROFILES

Demersal shark longline

In the 1990s, over 30 permits were issued to target shark (pelagic and demersal species combined). Many of the permits were not utilized as permit holders generally held permits in other more lucrative fisheries. The initial incentive to obtain these permits was to exploit loopholes in the regulations to catch hake by longline, banned in 1990 (Crawford et al., 1993). Due to poor performance the number of permits was decreased to 11 in 2004 and finally to six permits in 2005. Due to the steep learning curve in catching and marketing demersal sharks catches of soupfin (*Galeorhinus galeus*) and common smoothhound sharks (*Mustelus mustelus*) only increased in this fishery in 2006. In 2010 catches of sharks were as follows: soupfin (106 t), common smoothhound (110 t), bronze whaler sharks (*Carcharhinus brachyurus*) (32 t) and skates (Rajidae.) (33 t).

The current demersal shark longline is restricted to coastal waters and uses weighted longline with hooks to target soupfin, smoothhound spp, dusky (*C. obscurus*) and bronze whaler sharks. The fishery is currently restricted to a Total Applied Effort (TAE) of 6 vessels. As a precautionary measure the fishery is prohibited from fishing North of East London, where biodiversity increases and the continental shelf narrows up the East Coast of South Africa. Vessels are tracked by a Vessel Monitoring System (VMS) that directly links to the Fisheries Management base station. All landings are independently monitored and skippers are required to complete logbooks per longline set. There is generic reporting of skates and carcharhinid species. There is an overlap of species caught in this fishery with the traditional linefish fishery and the recreational fishery.

Large pelagic longline fishery

The large pelagic longline fishery was established in 1997 as an experimental fishery. This fishery uses pelagic longline to target swordfish (*Xiphias gladius*), yellowfin tuna (*Thunnus albacores*) and bigeye tuna (*Thunnus obesus*) along the entire coastline of South Africa. Sharks accounted for 30-40% of the catch. Blue shark (*Prionace glauca*) is the most common shark species caught followed by shortfin mako sharks (*Isurus oxyrinchus*). Other sharks caught include silky shark (*Carcharhinus falciformis*), thresher shark (*Alopias vulpinus, A. pelagicus and A. superciliosus*), oceanic whitetip (*Carcharhinus longimanus*), scalloped hammerhead (*Sphyrna lewini),* and other Carcharhinid species. The large pelagic fishery was formalized into a commercial fishery in 2005 with the allocation of 18 swordfish and 26 tuna-directed long-term fishing rights. One of the goals of the allocation was also to terminate the directed pelagic shark fishery by issuing large pelagic rights to the shark fishers. Due to an administrative oversight the amalgamation of the fisheries never occurred and seven shark fishers were granted exemptions until March 2011 to target pelagic sharks (mainly targeting blue and shortfin mako sharks). For the period 2005 to March 2011 there were two fisheries which caught pelagic shark species. During this period the large pelagic fishery was restricted to a 10% by-catch limit of sharks (i.e. sharks landings could not exceed 10% of the weight of the targeted swordfish and tuna species) and wire traces were banned. In 2010 the pelagic shark fishery landed 515 t of shortfin mako, 198 t of blue sharks, 25 t of bronze whalers and 9 t of skates. In the same year the large pelagic longline fishery landed 66 t shortfin mako and 100 t of blue sharks. In April 2011 the directed pelagic shark fishery was terminated when six shark fishers were allocated large pelagic rights.

Shortfin mako sharks *I. oxyrinchus* being prepared for market aboard a tuna longline vessel (Photo: Craig Smith)





In the current large pelagic fishery, sharks are managed under a Precautionary Upper Catch Limit (PUCL) of 2 000t per annum, based on shark catch ratios during the experimental fishery when no shark by-catch restrictions applied and extrapolating for the development of the tuna/swordfish fleet. In addition foreign charter vessels are restricted to a 10% shark by-catch limit and these vessels have 100% observer coverage. Observer coverage was targeted at 20% for domestic vessels, but due to the expiry of the observer contract with the service providers no observer coverage could be obtained for domestic vessels during 2011. Observers typically record species composition, length frequencies, live releases,

Silky sharks (*C. falciformis*) are caught occasionally by tuna longline vessels but are released according to permit conditions (Photo: Charlene da Silva)

Crocodile sharks (*Pseudocarcharias kamoharai*) are caught occasionally by tuna longline vessels and are usually released (Photo: Charlene da Silva)

Blue shark (*P. glauca*) one of the most commonly caught shark in the large pelagic fishery being tagged with a satellite tag during National research surveys aboard the *RV Ellen Khuzwayo* (Photo: Charlene da Silva)

Blue shark (*P. glauca*) released with a satellite tag fitted during a National large pelagic research survey aboard the *RV Ellen Khuzwayo* (Photo: Charlene da Silva)

and discards. All vessels in this fishery are monitored by VMS. All landings are weighed and independently monitored. Logbooks are required to be completed on set-by-set basis. All fisheries data pertaining to pelagic sharks are submitted to ICCAT and IOTC on an annual basis but South Africa's capacity to send experts to RFMO scientific meetings is still a concern. Shark finning is banned in terms of permit conditions. Landings of certain shark species are banned due to concern over their conservation status namely, silky sharks, oceanic whitetip, all thresher sharks, and all hammerhead sharks. The correct identification of some shark species by fishers and MCS personnel remains a challenge.

Kwazulu-natal bather protection program

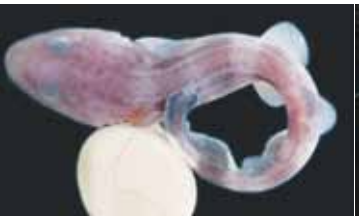
The KwaZulu-Natal Sharks Board (KZNSB) operates a bather protection program that uses shark nets and drumlines from Richards Bay to Port Edward. The primary objective of the program is to protect bathers and other resource users from shark attack – principally, from those sharks that are regarded as potentially dangerous. This is achieved by reducing the local populations of the target species at designated bathing beaches. Thie species targeted include large carcharhiids and lamnids, but other shark species, turtles, rays and dolphins are also caught. Between 1999 and 2004 the number of nets at most beaches

was reduced in order to reduce catches of marine animals. Between 2005 and 2007, 79 drumlines were introduced in place of some remaining nets as a measure to reduce by-catch but without compromising bather protection. The total catch of sharks and rays in 2010, excluding animals released alive, was 35 t. All mortalities are biologically sampled and have contributed substantially to life-history studies. One of the problems with this program is that the target reference level is set to minimise attacks on bathers. This target reference level may be below the biologically sustainable level. In terms of the provincial KwaZulu-Natal Sharks Board Act, 2008 (Act 5 of 2008), the KZNSB is required to endeavour to introduce schemes that will reduce negative impact on all biodiversity. In addressing biodiversity issues the KZNSB has already reduced the number of nets, introduced drumlines, and has removed shark fishing gear during the annual winter sardine run.

Traditional linefishery

The linefishery is considered the oldest fishery to have historically targeted sharks, predominantly soupfin in the 1940's as a source for vitamin A. Post World War II sharks were targeted as a cheap source of protein for African countries. More recent catches have been driven by market demand and the seasonal availability of target teleost species. The linefish fishery was an open-access fishery until 1984. In 1985 the fishery was capped at around 3200 vessels. Focused research on linefish species in the ensuing decade had identified that many of the target teleost species were compromised. Subsequently effort levels were reduced in the fishery to the current level of 450 vessels (and a maximum crew of 3 450), all of whom which retain access to sharks. Vessel size is typically less than 10m and consists of small motorized vessels. Species targeted include soupfin, common smoothhound,

Soupfin sharks (*Galeorhinus galeus*) caught by the commercial linefishery in Western Cape fishing villages in the 1940's (DAFF Archival picture)




hardnose smoothhound (*M. mosis*) and whitespotted smoothhound (*M. palumbes*), Carcharhinid spp. smooth hammerhead (*S. zygaena*) and Rajidae. Shark catches in the linefishery in 2010 were reported as soupfin (89 t), houndsharks (25 t), Carcharhinid sharks (64 t), blue sharks (13 t) and skates (59 t).

The traditional linefish fishery operates along the entire length of the South African coastline. Vessels are monitored by VMS. Landings are not monitored, but land-based observers have been placed at primary harbours/ slipways to determine species composition, biological samples, and length frequencies. Daily catches are recorded in logbooks and are submitted on a monthly basis. Logbook data are not verified and are considered to under-estimate the total shark catch. Furthermore, catches are not reported on species level. Shark species caught in this fishery are the same as those targeted by the demersal longline fishery and the recreational linefish fishery.

St Joseph fishery

A directed shark fishery for Ploughnose chimeras, locally referred to as St. Joseph sharks (*Callorhinchus capensis*), operates on the west Coast of South Africa and is managed on a TAE of 162 rights holders. Landing of other sharks is not allowed due to a history of illegal fishing in this sector. The St Joseph shark net fishery employs 178 mm stretched mesh, monofilament, bottom-set gill nets. The nets have a fall of 3m and are no longer than 150m. The fishery is an effort based fishery confined to the west coast. The fishery is intrinsically associated with the “haarder (cape mullet) fishery. Only 80 of the 177 gillnet permits available in 2002 allowed the use of Joseph nets, all within the St Helena Bay fishing Area. The permit entitles the holder to have in their possession two St Joseph and two mullet-directed (haarder: Liza spp.) gill nets at any-one time. Those individuals that have permits that are restricted to “haarder” may only be in possession of two “haarder” gill nets. They are however entitled to retain any St Joseph by-catch. Originally catches were in the order of 650 tons of St Joseph per annum. The reduced St Joseph catches by the gillnet fishery may be linked to increased trawl catches, but could also be due to the gillnet fishery targeting breeding aggregations. The time series of abundance indices from west coast surveys shows a decline in St Joseph from 1997 to 2004 followed by an increase in the last few years so that the overall trend is slightly negative however the slope is not significantly different from zero.

St. Joseph sharks (*Callorhinchus capensis*) caught by the netfishery in the 1970s (DAFF Archival picture)





Recreational linefishery

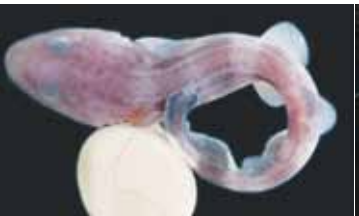
The recreational linefishery includes shore anglers, boat-based fishers and estuarine fishers (all of which use rod and reel), as well as spearfishers. An estimated 850 000 people participate in the shore-based recreational fishery alone. Boat-based fishing is conducted from ski-boats which are generally less than 10 m in length. Recreational fishing in South Africa is regulated by output control in terms of bag-, size and area limits and requires the purchase of a permit. Catches of most sharks are restricted by a bag limit of one shark per day and the sale of the catch is not permitted. Illegal sale of shark catches are of concern together with the exceeding of bag limits. Recreational fishers are not required to report any catches to Fisheries Management. Another challenge is posed by recreational tournament fishing, which remains unregulated. The catch and release of sharks, although promoted, may also pose a problem as there is little information on post-release survival.

BY-CATCH SHARK FISHERY PROFILES

Tuna pole

The commercial tuna pole fishery started in 1979 with the initial targeting of yellowfin tuna in the first year. Thereafter albacore has been the primary target species of this fishery. The fishery operates from September to May along the west coast of South Africa. In 2006, 191 long-term fishing rights were allocated to use 198 vessels and a crew of 2950 to target albacore and yellowfin tuna. The fishery does not have a history in catching shark, but the use of rod and reel gear since 2003 to target yellowfin tuna has resulted in increased encounters with pelagic sharks. The landing of sharks is currently banned in terms of permit conditions and hence all sharks are required to be released at sea. There is no on board observer coverage for this fishery and hence it is unknown whether proper release procedures are implemented to ensure the

Recreational fishers competing in an angling completion in the Langebaan Lagoon (Photo: Robert Tarr)




post-release survival of sharks. The tuna pole fishery is monitored by VMS and skippers are required to record catches in a daily logbook, which is submitted to Fisheries Management on a monthly basis. A pilot monitoring program has been conducted in 2012 for 100% monitoring of discharges in this fishery.

Hake longline

The demersal hake long-line fishery was initiated in 1994, and has since attained commercial status with the first 50 rights being allocated in 1998. The fishery comprises two zones: the West Coast fishery that targets the deep water hake *Merluccius paradoxus*, and the South Coast fishery that targets the shallow water hake *Merluccius capensis*. An observer by-catch program is operational in this fishery. Unfortunately, the shark by-catch component is recorded at a group level – species identification is not undertaken. Nevertheless, the shark by-catch usually comprises less than 0.5% of the total catch. A kingklip (*Genypterus capensis*) directed fishery was initiated in 1983, however a subsequent stock collapse curtailed operations, and the fishery had to be closed in 1990. Nevertheless, while in operation, there was an appreciable shark by-catch component to this fishery (D.Japp, per. comm.). A total of 4 tons of unidentified "sharks, skates and rays" was reported in 2010.

Trawl

There are several trawl fisheries in South Africa the largest of which is the south and west coast demersal component targeting the Cape hakes *Merluccius capensis and M. paradoxus* and other lucrative benthic species; the demersal prawn trawl fishery situated on the east coast along Kwa-Zulu Natal and a midwater trawl fishery targeting horse mackerel along the south coast. The trawl fishery for Cape hakes can be separated into two distinct fishery sectors, namely the offshore and inshore trawl components. Trawl fisheries targeting hake provide over half of the value of all fisheries in South Africa and account for more than 50% of the total value of the combined South African fisheries. The development of trawling in SA commenced in 1890 and remains centered on the South African hake resource which comprises two species, the shallow-water Cape hake and the deep-water Cape hake. Prior to the declaration of the 200 nautical mile South African EEZ in 1977, the Cape hakes were subjected to increasing levels of exploitation after the First World War, with the incursion of foreign fleets during the 1960s culminating in a peak catch of close to 300 000 t in the early 1970s. Subsequent to 1977 and the declaration of the EEZ, South Africa implemented a relatively conservative management strategy by imposing Total Allowable Catches (TACs) set at levels aimed to rebuild the hake stocks, and annual catches have subsequently remained relatively stable in the 120 000 – 150 000 t range. The hake TAC is determined annually by the application of an Operational Management Plan (OMP). In 2004 the South African demersal trawl fishery obtained Marine Stewardship Council (MSC) certification and this eco-labeling has resulted in additional focus on the management of by-catch species.

Inshore trawl

The inshore fishery targets primarily both hake species and East-coast sole (*Austroglossus pectoralis*) and is restricted to the area between Cape Agulhas (20° E) in the west and the Great Kei River in the east. The vessels operating in the inshore fishery are wetfish trawlers which are smaller than those active in the offshore fishery. These vessels may not be larger than 30 m. Although there are ecosystem-based management measures being developed for this fishery, there are significant by-catch issues. Chondrichthyan by-catch in this fishery is common, and includes considerable quantities of a large number of species, including Squalus spp, Scyliorhinids, soupfin sharks, smoothhound, rays and skates being caught (Attwood et al 2011).

In the past decade the number of vessels in this sector has dropped from a historic level of around 32 vessels to 24 vessels operating currently. All vessels in this sector are monitored by VMS and all the landed catch is monitored. A proportion of the operations at sea is





subjected to monitoring via the Scientific Observer Program which has attained a maximum coverage of 4.4% of trawls (Attwood et al., 2011). All discharges from the inshore demersal trawl fleet are subject to discharge monitoring but generic categorization of products remains challenging.

Offshore trawl

The offshore hake trawl industry in South Africa is one of the largest sectors of the marine fishery. Offshore vessels are restricted from operating deeper than 110m on the south coast. There is no restriction on the west coast, but they do not operate shallower than 200m.Therefore, the vessels used in this fishery are mostly large, powerful, ocean-going stern trawlers. A comprehensive Scientific Observer Program has collected information on target and non-target species, the results of which have been used in management advice. Furthermore, measures to reduce impacts on benthic habitat have been introduced, including 'ring-fencing' existing trawling grounds to reduce the amount of habitat affected. Surveillance capacity has also increased, and the entire hake fishing fleet is now covered by a Vessel Monitoring System (VMS). Trawling is a particularly unselective fishing method, and thus produces a high level of by-catch. Species caught include deepwater sharks, skates and rays. Low value shark species are discarded only once the main catch has been sorted, potentially resulting in an increased mortality of released by-catch species. Generic reporting of species is a common occurrence. Presently the offshore trawl landings are largely not monitored during discharge and catch information is thus seldom verified.

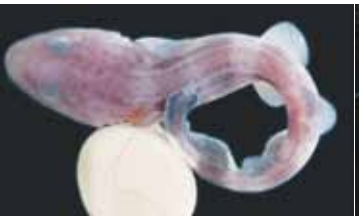
Midwater trawl

Historically adult Cape horse mackerel (*Trachurus capensis*) have been caught as by catch within the offshore hake trawl sector. In the 1960s the bulk of the adult horse mackerel catch was taken by purse-seine on the west coast, but that resource has disappeared. A Japanese midwater trawl fishery operated off the South Coast during the 1980s and 1990s .The annual catch limit varied from 34 000t to 54 000 t during that period. In the late 1990s the Japanese fleet was replaced with South African vessels with a catch limit of 34 000 t divided between midwater trawl and demersal trawl. In about 2010 the Precautionary Upper Catch Limit (PUCL) was raised to 44 000 t (31 500t – allocated to Right Holders for targeted midwater trawl fishing and 19 500 held in reserve to cover by-catch in the demersal trawl fishery). (The bulk of the catch is made by one vessel of 121 meters with a gross tonnage of 7628t using a midwater trawl capable of making catches of up to 100t per trawl. The horse mackerel fishery is restricted to the south coast (west of Cape Agulhas). An experimental midwater trawl fishery for round herring (*Etrumeus whiteheadi*) and anchovy (*Engraulis encrasicolus*) has been recently established on the west coast. The vessels use excluder devices to reduce the capture of marine mammals and pelagic sharks.

A number of species of pelagic shark are recorded in the by-catch all of which is discarded once the main catch has been sorted, potentially resulting in an increased mortality of released by-catch species. Permit conditions require a scientific observer to be present on all trips.

Prawn trawl

The South African prawn trawl fishery operates in shallow water (< 50 m) around the Tugela Bank (KwaZulu-Natal), and in deeper water (300-500 m) between Cape Vidal and Amanzimtoti. Catches (by mass) of the prawn fishery consist of roughly 20 percent target species, 10 percent retained by-catch and 70 percent discarded by-catch. Chondrichthyans are mainly discarded, with the exception of squalid at times. The trawl vessels employed in the fishery tend to be small (24-33m length), and use 50mm stretched cod-end mesh nets. Shallow water chondrichtyan by-catch include stingrays (Dasyatidae), hammerhead sharks (Sphyrnidae), requiem sharks (Carcharhinidae), angelsharks (*Squatina africana*) and catsharks (Scyliorhinidae). Deepwater by-catch is dominated by Squalus spp and rajids (Dipterus spp and Cruiraja spp).




The fishery is managed on a TAE basis with seasonal shallow water area restrictions designed to mitigate catches of juvenile linefish (Fennessy, 1994). Although there has been a decline in prawn trawl fishing effort in recent years there is nonetheless concern that the fishery operates in a region recognized as a shark biodiversity hotspot, particularly for regionally endemic demersal shark species. Some data have been collected by a scientific observer program during the past 10 years.

Beach seine fisheries

The beach seine fishery has operated traditionally since 1652 and operates from False Bay to Port Nolloth. In 2001, a reallocation of rights saw a reduction in fishing effort from around 200 to 28 beach seine operations. Nets range from 120m to 275m in length with net depths varying according to fishing area, but may not exceed 10m (Anon, 2010b). Nets have a stretched mesh of 48mm and minimum cod end size of 44mm. This fishery primarily targets teleosts; however considerable quantities of shark are also caught (Lamberth, 2006). With the exception of protected shark species status such as great white sharks (*Carcharhinus carcharias*), raggedtooth sharks (*Carcharias taurus*), spotted gully sharks (*Triakis megalopterus*), pyjama sharks (*Poroderma africanum*), and leopard catsharks (*Poroderma pantherinum*) no by-catch restrictions for sharks exist within this fishery. There is also a sardine and a mixed fish beach seine fishery in Kwazulu-Natal. Chondrychthyan catches are typically minimal in these fisheries with most by-catch released alive.

Patagonian toothfishery

The Patagonian Toothfish fishery started as an experimental fishery in 1996 and targeted toothfish (*Dissostichus eleginoides*) using Spanish longline around Prince Edward and Marion Islands (an extension of South Africa's EEZ). Five permit holders used two vessels to fish their experimental allocation of 3 000 t. The fishery was formalized into a commercial fishery in 2005 where five long-term rights were allocated on board two vessels. Only one vessel has been fishing up until 2011. In 2011 a second vessel joined the fishery and the fishing method changed to trot lines. The current TAC is 320 t of Patagonian toothfish. As the fishery is not permitted to retain sharks all sharks are released at sea. The fishery is stringently managed with VMS reporting, observer coverage (one observer per vessel) and monitoring of all landings. Daily logbooks are required to be completed by set. Shark catches are considered small, but there is concern regarding the identification of shark species and the impact the fishery could have on species that are long-lived and sensitive to fishing pressure. Hence, protocols for shark release procedures are needed and require enforcement.

Rocklobster fishery

The West Coast rocklobster (*Jasus lalandii*) fishery is separated into an inshore fishery using hoopnets and an offshore component using traps. No sharks are caught in the hoopnets, however catches in the offshore component may be significant. Sharks caught in traps include Scyliorhinids which may not be sold for commercial purposes and are consequently discarded. The main concerns therefore relate to fishery mortality and handling mortality.

Aquarium trade

Limited trade of raggedtooth sharks, small Carcharhiniformes and rays exists in South Africa. Sharks are caught with rod and line and transported to the aquarium or holding facility. A small number of sharks are exported to international aquariums per year. This trade is currently managed on an *ad-hoc* basis and a formal regulatory framework might be needed.

Markets

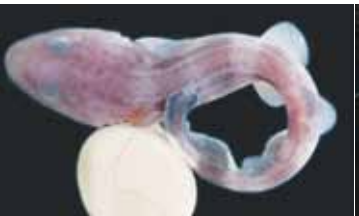
The Marine Living Resources Act (MLRA, 1998) regulates all fisheries in South Africa, including aspects of the processing, sale and trade of most marine living resources. In terms of the MLRA, sharks may not





be landed, transported, transshipped or disposed of without the authority of a permit. The market is divided into three separate components, (1) processing and filleting demersal shark carcasses or “logs”, (2) fin drying, and (3) processing and exporting of pelagic shark steaks. Each component operates separately although fins are contributed by both demersal and pelagic sharks. In the demersal shark fillet trade processed “logs” are separated depending on the value of the flesh determined by the handling, cleaning processes and mercury content. In general, sharks between 1.5kg-12kg are considered ideal as mercury levels of sharks over 12 kg exceed permissible limits (da Silva and Bürgener, 2007). In the past decade, the export market for South African shark meat has grown considerably. The majority of processed shark is sold to Australia, where there is high consumer demand for shark fillets. Big and/or low value animals are dried and sold as dried fish sticks. All fins are dried and exported to Asian markets. The increased fin price provides strong incentives for the targeting of large sharks regardless of fillet value. Pelagic shark carcasses are mainly exported to Europe with some species, namely shortfin mako and porbeagle, exported to Asia.

A recent analysis of trade data between South Africa and Australia indicated discrepancies in import versus export statistics. Thus, it does not currently appear feasible to use trade data as a proxy indicator for shark catches in South Africa. A detailed description of the South African shark meat harvest, including processing, handling and export information, can be found in Da Silva and Bürgener (2007).




From issues to action

Although South Africa has come a long way in the development and implementation of shark management since the conception of the IPOA in 2001, the following issues need to be addressed to achieve the goals set out in the vision of the NPOA-Sharks. The broad challenges identified here mirror those identified in the IPOA and in NPOAs of other countries. The Challenges are clustered around seven broad groups: *Data and reporting, Classification and assessment, Sustainable management, Optimum use, Capacity and infrastructure, Enforcement of compliance and Regulatory tools.* The individual issues are specific to the South African context and require particular actions by one or more stakeholder groups. Suggesting responsibilities for remedial actions will enable South Africa to effectively implement these actions within the suggested timeframes. As many issues are interlinked and require a particular sequence of actions, the actions were prioritized to make the execution of this plan viable within its four –year life span. Priorities are given on four levels*, Immediate, High, Medium and Low* and required timeframes are indicated to facilitate progress monitoring and evaluation. As there is limited budget dedicated to the implementation of this plan, the actions are expected to be achievable within existing allocations of funds to research, management and conservation agencies. As the lack of shark-specific funding has been identified as one of the issues, the application for additional funding from international agencies should be facilitated after the formal adoption of this plan.

Table 2. An overview of issues facing particular fisheries divided into clusters with proposed action, responsibilities, priorities and timeframes.

Issue cluster	Issue	Description	Fishery sector	Action	Respon-sibility	Priority	Time-frame
Data and reporting	Shark species identification and reporting	In catch statistics, sharks are often lumped into generic categories.	All Fisheries excluding the KZN bather protection program	Create a identification guide	FRD	Immediate	1
				Develop permit conditions	MRM	Immediate	1
				Education and Implementation	MRM Working Groups	High	2
				Review progress	FRD and MRM	Medium	3-4





Issue cluster	Issue	Description	Fishery sector	Action	Respon-sibility	Priority	Time-frame
	Observer coverage	There is currently no observer coverage except for the foreign flagged pelagic tuna longline fleet.	All sectors excluding the KZN bather protection program	Re-establish, re -assess and expand observer coverage	FRD	Immediate	1
		Observer programs do not collect data that are adequate to assess impact of fishing on species that are not landed.	All sectors excluding the KZN bather protection program	Define and set sampling requirements per fishery sector	FRD	Immediate	1-2
				Initiate new sampling strategy	FRD	High	2-4
	Discharge monitoring	Discharge of fish is only monitored in selected fisheries. Catch reporting is not verified.	Offshore trawl, traditional linefish, tuna pole,	Review discharge monitoring coverage and quality of information	FRD, MCS	High	1-2
				Establish additional discharge monitoring requirements	FRD and MCS	High	2-3

Issue cluster	Issue	Description	Fishery sector	Action	Respon-sibility	Priority	Time-frame
	Reporting of directed catch and "joint product'"	Directed catches of sharks are only reported for commercial sectors.	Recreational linefish	Develop and implement a land based monitoring program expanding coverage	FRD	High	1-2
		Landed catch is not weighed	Line, net fish and recreational linefish	Instigate monitoring of landings	FRD, MRM and MCS	Medium	2-4
		There is no mandatory reporting	Recreational fishery	Engage with recreational initiative for web-based catch recording	FRD and Recreational MRM Working Group	Medium	2-4
		There is no routine collection of length frequencies and conversion factors do not exist for most species.	All except Large Pelagic longline	Set target for observer coverage	FRD	High	1
				Develop morphometric relationships to allow for conversion factors	FRD	High	1-2
		Shared stocks	All fisheries	Identify overlaps	FRD and MRM	High	1-2
				Engage with neighbouring countries and set-up data sharing agreements	MRM	Medium	3-4

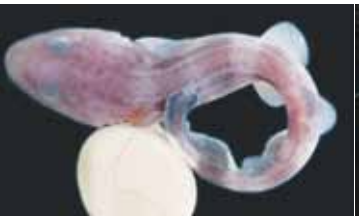
Issue cluster	Issue	Description	Fishery sector	Action	Respon-sibility	Priority	Time-frame
	Estimation of discards	Unable to quantify total shark mortality associated with by-catch fisheries	All fisheries	Identify short falls	FRD	High	1
				Develop monitoring procedures and implement through observer program	FRD	High	1-3
Classi-fication and assess-ment of shark species	Gaps in taxonomy	Taxonomical classification is uncertain for a number of shark species	All fisheries that catch rays, skates and deepwater shark species	Reclassification of all rays, skates and deepwater shark species using genetics and morphometrics (Barcoding of Life Programs)	FRD	Immediate	Ongoing
	Stock delineation	There are several stocks that might be genetically distinct to areas in SA, while others are appear to be shared with other countries.	All fisheries	Collection of additional genetic material through national research surveys and observer program	FRD	Medium	Ongoing

Issue cluster	Issue	Description	Fishery sector	Action	Respon-sibility	Priority	Time-frame
	Gaps in the knowledge of life history	For many species, basic information on life history i.e. age and growth and reproductive capacity is not available or fragmented.	All fisheries	Gap analysis example South African marine status reports	FRD	Immediate	1
				Prioritise species	FRD	High	1
				Source research capacity i.e. students	FRD	High	1
				Collect and work up biological material from national research surveys and observer program	FRD	High	1-3
	Spatio-temporal behaviour	Information gaps exist around spatio-temporal behaviour i.e. identification of nursery and mating areas for live-bearing sharks.	Most fisheries	Reference gap analysis	FRD	Immediate	1
				Prioritise species	FRD	High	1
				Source research capacity i.e. students	FRD	High	1
				Collect and work up biological material from national research surveys and observer program	FRD	High	1-3





Issue cluster	Issue	Description	Fishery sector	Action	Respon-sibility	Priority	Time-frame
	Ecosystem changes induced by fishing	Habitat alteration through Fishing activities i.e. pupping grounds of demersal sharks.	Inshore and offshore trawl	Engage with EcoFish project that is investigating the trawl effects of the benthos	FRD	Medium	ongoing
		Cascading effects on the ecosystem by the removal of apex predators	All fisheries	Ecosystem modeling using ecosym and ecopath	FRD	Low	Ongoing
	Lack of formal assessments	Formally, for stock status only three of the 98 species have been assessed compre-hensively, a further 14 species were assessed for the KZN region.	All fisheries	Prioritize species for assessment	FR	High	1-2
				Identify suitable assessment models	FRD	High	1-4
				Collect and collate relevant material	FRD	High	1-4
				Undertake assessments	FRD	High	1-4




Issue cluster	Issue	Description	Fishery sector	Action	Respon-sibility	Priority	Time-frame
Sustain-able manage-ment	Lack of formal management protocol for target and "joint product species"	Two species were assessed in terms of a per-recruit and an ASPM, respectively, according to the available data. There is no formal protocol on assessments and recommend-ations in any of the fisheries.	All fisheries	Develop management protocol	FRD and MRM	High	1-2
				Implement management protocol	FRD	Medium	2-3
				Management actions (input control, output controls, Marine Protected Areas) based on protocol	MRM	Medium	2-4
	Lack of coordination of shark fishery management	Most sharks are caught by more than one fishery. Currently there is no formal mechanism for shark management across fisheries. Furthermore, no formal mechanism to consider non-extractive use i.e. tourism. Inter-sector conflict	All fisheries	Review fisheries and non-extractive impacts on sharks	MRM	High	1
				Integrate into management protocol	MRM	High	1-2
				All fisheries that involve sharks take the NPOA into account during the development and implementation of species specific management plans	MRM	High	4

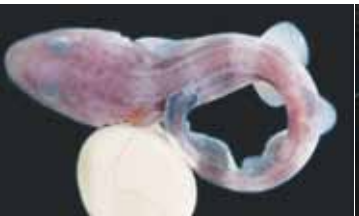
Issue cluster	Issue	Description	Fishery sector	Action	Respon-sibility	Priority	Time-frame
	Lack of funding	Funding for shark fisheries directed research and management is therefore limited		Explore funding opportunities from International agencies.	DAFF	Medium	2-3
Optimum use	Concern around health risk of shark meat consumption	High levels of heavy metal contamination are suspected for many top predators, including most shark species, making them potentially unsafe for human consumption.	All fisheries	Collect material from national research surveys and observers for priority species	FRD	Medium	1-2
				Analyze data	FRD	High	1-2
				Minimize catch as a safety precaution	FRD and MRM		
	Lack of knowledge or mechanisms to reduce fishery mortality	Mitigation measures for unwanted species Proper release protocols for unwanted by-catch	All fisheries	Review existing mitigation measures	FRD	Medium	2-4
				Develop best practice release protocols per fishery	FRD	Medium	2-4
				Incorporate best practice release protocols into Permit conditions	MRM	Medium	2-4

Issue cluster	Issue	Description	Fishery sector	Action	Respon-sibility	Priority	Time-frame
	Retained sharks are not fully utilized	Finning. Dumping of carcasses, killing of unwanted by-catch, no by-catch mitigation. There is no investigation into value adding and development of products i.e. shark leather etc. Large sharks are caught for fins and fillets not utilized.	All fisheries	International review of potential shark products	FRD		
				Engage Technicons and Universities to develop possible shark products, meat as well as leather and Review possible Pharmaceutical products	FRD and MRM	Medium	2-4
				Engage with relevant sections within DAFF regarding developing alternate livelihoods through full utilization of shark products ie. Leather, markets for unwanted low value species such as St. Joseph sharks	MRM	Medium	2 weeks





Issue cluster	Issue	Description	Fishery sector	Action	Respon-sibility	Priority	Time-frame
	Traceability of shark products from catch to sale	Product names cannot be matched with species names i.e. generic white fish	All fisheries	Introduce standardization of product codes/names	SASSI	High	1-2
		Custom HS codes only reflect generic sharks and not the individual species.		Engage with Customs to review product codes for export/import	MRM/ Traffic	High	1-3
		Fillet identification is a problem	All Fisheries	Review of genetic coding tools.	FRD Traffic	Medium	2-3
		Fins cannot always be identified to species level Illegal recreational sale		Fin identification guide	FRD	Medium	2-3

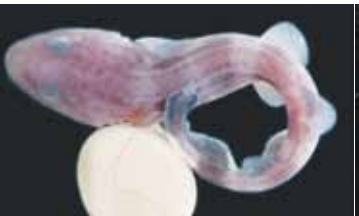



Issue cluster	Issue	Description	Fishery sector	Action	Respon-sibility	Priority	Time-frame
Capacity and infra-structure	Lack of awareness	Lack of awareness and education to change miscon-ceptions about sharks and shark fisheries Fishery pollution eg. discard of bait box packaging	All fisheries	Determine requirements for educational material	FRD & MRM	Medium	2-3
				Implement training and awareness program		Medium	3-4
				Ensure compliance with permit conditions	MCS and MRM	High	1-2
				Develop responsible fisheries programs pertaining to sharks	DAFF	Medium	3-4
	Lack of capacity	Lack of scientific capacity to timeously complete assessments and biological analysis		Develop departmental capacity and where necessary outsource shortfalls	DAFF	High	1-2
		Repre-sentation at shark international scientific working groups and stock assessment working groups of relevant RFMO	Large Pelagic Fishery	Shark expert from FRD attend relevant international meetings	DAFF	Immediate	Ongoing





Issue cluster	Issue	Description	Fishery sector	Action	Respon-sibility	Priority	Time-frame
Com-pliance	Lack of enforcement	Finning of pelagic sharks Inability to identify shark species Recreational sale of commercially valuable shark species Exceeding recreational bag limits Interpretation and knowledge of permit conditions pertaining to sharks	All Fisheries	Development of a monitoring and enforcement strategy	DAFF: MCS with input from FRD and MRM	High	1-2



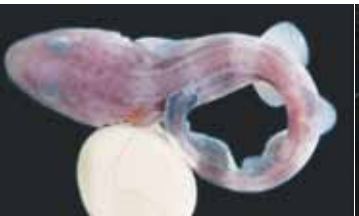

Issue cluster	Issue	Description	Fishery sector	Action	Respon-sibility	Priority	Time-frame
Regula-tory Tools	Inadequate regulatory Reference to sharks	Shark fishing competitions are not regulated adequately Fisheries specific permit conditions pertaining to sharks are not informed by overarching regulatory frameworks Inadequate measures to control imports and exports of sharks.	All Fisheries	Review and develop regulatory tools	Legal with input from FRD and MRM	Immediate	1

Monitoring and Evaluation

The Fisheries Management Branch at DAFF has been the lead agency for drafting the NPOA-Sharks and will remain responsible for coordinating its implementation. Collectively, the Chief Directorates Marine Resource Management and Fisheries Research and Development will be responsible for assessing the overall implementation of NPOA-Sharks during its operational period. The structure of the plan, with actions prioritized by a delivery timeline, should enable the Fisheries Management Branch to iteratively monitor progress. Progress will be evaluated annually by the EAF-working group. Upon conclusion of the four-year operational period of the plan, the overall progress of the NPOA-Sharks will be evaluated against its goals and objectives. The layout allows for an assessment of individual actions, their outputs and their outcome in terms of the overall vision. If an action is not completed, an explanation for the lack of completion should also be included.

Table 3. Assessment framework for NPOA-Sharks.

Action	Responsible agencies	Original Timeframe	Output	Outcome	Challenges/ Reasons for not completing the action




References

Anon, 2010. Status of South African Marine Fishery Resources., p. 55. Inshore Resource Research, Fisheries, Department of Agriculture, Forestry and Fisheries.

Attwood, C.G., Peterson, S.L., Kerwath, S.E., 2011. Bycatch in South Africa's inshore trawl fishery as determined from observer records. ICES Journal of Marine Science In press.

Crawford, R.J.M., Wilkinson, I.S., David, J.H.M., Leslie, R.W., Stander, G.H., Oosthuizen, W.H., Schulein, F.H., 1993. Progress towards the development of an integrated management approach to fisheries for sharks and other chondrichthyans in South African waters. , pp. 1-31. Sea Fisheries Research Institute Task Group, Cape Town.

da Silva, C., Bürgener, M., 2007. South Africa's demersal shark meat harvest. Traffic Bulletin 21, 55-56.

Fennessy, S.T. 1994. The impact of commercial prawn trawlers on linefish off the north coast of Natal, South Africa. *South African Journal of Marine Science* **14:** 263-279.

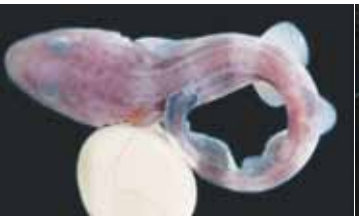
Lamberth, S.J., 2006. White sharks and other chondrichthyan interactions with the beach-seine (treknet) fishery in False, Bay, South Africa. African Journal of Marine Science 28, 723-727.





Acknowledgements

Thanks go to the staff of the Fisheries Component of the Department of Agriculture, Forestry and Fisheries for technical and logistical support. Special thanks go to the task group from the Large Pelagic and Shark working group: Dr. Sven Kerwath, Mr. Chris Wilke, Mr. Craig Smith, Ms. Larvika Singh and Ms. Charlene da Silva for collation of NPOA-Sharks. Special thanks to all members, observers and invited experts from the Chondrichthyan Working Group 1998-2010 that completed previous drafts of the NPOA-Shark. Special thanks to Dr. Leonard Compagno, Dr. Malcolm Smale and Dr. Sheldon Dudley for their invaluable assistance with previous drafts and shark assessment reports. Furthermore we would like to thank our Colleagues at the Department of Environmental Affairs (DEA).




Appendix 1

SHARKS IN SOUTH AFRICA

L.J.V. Compagno

Species composition of south africa sharks

Despite its relatively short coastline, South Africa has one of the most diverse faunas of cartilaginous fishes (Class Chondrichthyes) in the world. South Africa possesses representatives from all of the 10 orders, and most of the living families of cartilaginous fishes. Cartilaginous fishes are primarily marine, with about 5% penetrating fresh water. Most species are known from the intertidal to the epipelagic zone and the mid-slope, there are however a few deep slope (below 1500 m) and mesopelagic or bathypelagic taxa.

Classification of taxa

Cartilaginous fishes are divided into two subclasses, Elasmobranchii for sharks and rays and Holocephalii for the chimaeras. The major features of the synthetic classification include the subdivision of the living

Table 1. Comparison of relative numbers of species of South African and world chondrichthyan fauna

Taxa	World		South Africa	
	Nº. species	% total	Nº. species	% total
Class Chondrichthyes	1171	100.0	181	100.0
Subclass Elasmobranchii	1121	95.7	172	95.6
Superorder Galeomorphii	336	28.6	66	37.1
Order Heterodontiformes	9	0.8	1	0.6
Order Lamniformes	15	1.3	12	6.6
Order Orectolobiformes	34	2.9	3	1.7
Order Carcharhiniformes	278	23.7	51	28.2
Superorder Squalomorphii	785	67.0	106	58.7
Order Hexanchiformes	6	0.5	5	2.8
Order Squaliformes	119	10.2	33	18.2
Order Squatiniformes	18	1.5	1	0.6
Order Pristiophoriformes	9	0.8	1	0.6
Order Rajiformes	633	54.1	66	36.5
Suborder Pristoidei	7	0.6	3	1.7
Suborder Rhinoidei	1	0.1	1	0.6
Suborder Rhynchobatoidei	6	0.5	1	0.6
Suborder Rhinobatoidei	47	4.0	5	2.8
Suborder Platyrhinoidei	3	0.3	0	0.0
Suborder Zanobatoidei	4	0.3	0	0.0
Suborder Torpedinoidei	77	6.6	6	3.3
Suborder Rajoidei	286	24.4	24	13.3
Suborder Myliobatoidei	202	17.3	26	14.4
Subclass Holocephali				
Order Chimaeriformes	50	4.3	8	4.4

elasmobranch fishes or neoselachians into two superorders: the Galeomorphii and the Squalomorphii. The Galeomorphii includes four orders, the Heterodontiformes (bullhead sharks), the Lamniformes (mackerel sharks), the Orectolobiformes (carpet sharks), and the Carcharhiniformes (ground sharks). The Squalomorphii include the Hexanchiformes (cow and frilled sharks), the Squaliformes (dogfish sharks), the Squatiniformes (angel sharks), the Pristiophoriformes (sawsharks), and the Rajiformes (batoids). While living elasmobranchs were usually subdivided into two major groups, Selachii (sharks) and Batoidea (rays); phyletic studies suggest that the batoids are best included as a large and diverse order of 'flat sharks' (Rajiformes) within the Squalomorphii. The Rajiformes are the immediate sister group of the Pristiophoriformes, and with them forms the sister group of the Squatiniformes.

South African chondrichthyofauna include representatives from all 10 orders of cartilaginous fishes, 44 of the 60 families (73%), 100 out of 189 genera (53%), and over 181 of the 1171 world species (15%) (Table 2.1). With respect to world Chondrichthyan fauna, South Africa has similar relative numbers of species of chimaeroids, but has higher numbers of squaloids, lamnoids, hexanchoids, carcharhinoids, and lower numbers of orectoloboids (which are most diverse in the Western Pacific). The batoids (Rajiformes) are the largest order of sharklike fishes, but with respect to the world fauna, are found in far fewer relative numbers off South Africa (37%). In addition, batoids outnumber other chondrichthyans by 54%. The approximately nine batoid suborders also show divergence between Southern Africa and the world, with South Africa having relatively more Pristoids and fewer Rhinobatoids, Rajoids and Myliobatoids. In addition, there is no representation of the small suborders Zanobatoidei (West Africa) and Platyrhinoidei (North Pacific). In part, this suggests that batoid diversity, particularly of deep-water rajoids and tropical East Coast myliobatoids, may increase with further exploration of the South African chondrichthyofauna. There are many species of cartilaginous fishes currently known from Namibia and Mozambique waters that in the future, are likely to be found in South African waters.

The Prince Edward Islands (Marion and Prince Edward Islands) are isolated South African possessions in the Southern Indian Ocean. Their sub-Antarctic chondrichthyan fauna is little known, and has only been elucidated through the activities of international long-line vessels fishing for Patagonian toothfish (*Dissostichus eleginoides*, Family Nototheniidae). So far, two of the three species recorded (*Hydrolagus* sp. and *Lamna nasus*) are also known from South Africa but the third, *Amblyraja* sp. is presently not recorded, and is of uncertain identity. It is probable that additional collections will reveal more species around the Prince Edward Islands, and include *Somniosus antarcticus*, which occurs nearby on the Crozet Plateau about 500 km NNE of Prince Edward Island. In addition, it is likely that other species of skates and possibly squaloid sharks, chimaeras, and other taxa will be discovered in the area.

Distribution patterns

The South African chondrichthyan fauna is zoogeographically complex, and includes a variety of unique species. These include wide ranging species, local endemics and regional Southern African endemics that have minimal overlap with adjacent areas. South Africa, and by extension Southern Africa, is a center of endemism for a variety of taxa, most notably members of the catsharks (Family Scyliorhinidae), finback catsharks (Proscylliidae), houndsharks (Triakidae), sawsharks (Pristiophoridae), dogfish (Squaliformes), skates (Rajoidei) and chimaeras (Chimaeriformes).

Distribution and habitat data are listed for all South African cartilaginous fishes.Distributions are based on those described by Compagno *et al.* (1989). Additional data is presented on range and depth extensions, and catch data on sharks and rays provided by the KwaZulu-Natal Sharks Board (G. Cliff and S. Dudley, *pers. comm.).* In essence, 38.7% of the species are wide-ranging, 27.1% are endemics, and 16.6% Indo-Pacific species. There are lesser contributions from other areas (Table 2).

While there may be some overlap in distribution, shelf chondrichthyans, and to some extent deep-slope

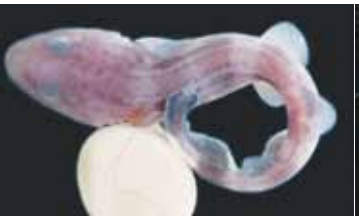



Table 2. Distribution types for South African cartilaginous fishes.

Distribution type	Nº. species	% total
Eastern Atlantic to South-Western Indian Ocean	8	4.4
Atlantic	7	3.9
Eastern Atlantic and Mediterranean	5	2.8
Atlantic coast of Africa	2	1.1
Southern African endemics	34	18.8
Subequatorial African endemics	5	2.8
South-eastern African endemics	1	0.6
South African endemics	15	8.3
Indo-Pacific	30	16.6
Western Indian Ocean	4	2.2
Wide-ranging	70	38.7
Total	181	100.0

species, can further be subdivided into cool-temperate, warm-temperate and subtropical-tropical species. Cool-temperate areas include the Northern Cape and Western Cape to Cape Point; warm temperate areas include the south coast of the Western Cape from False Bay to East London in the Eastern Cape; subtropical-tropical areas include the Transkei coast and KwaZulu-Natal. South African species are listed below by distribution off the provincial coasts (Table 3). Diversity increases from west to east, and from the Northern Cape to KwaZulu-Natal.

Habitat patterns

Cartilaginous fishes are broadly divisible by habitat into species of the *continental shelves* (the intertidal to about 200 m), the *continental slopes* (below 200 m to the ocean floor), and the *oceanic zone* (beyond the shelves and above the slopes and sea bottom). In comparison with some other areas - including the Eastern North Pacific - South Africa has a remarkably rich slope fauna. The slope fauna forms the largest habitat category (Table 4), followed by the continental shelf fauna. A few species penetrate fresh water. Very few South African cartilaginous fishes are oceanic, and the low diversity of cartilaginous fishes found in the oceanic zone reflects this. A few large sharks including the bluntnosed sevengill and white sharks have a wide range of habitats, and occur oceanically, on the slopes, and inshore. Some shelf species favour muddy bays or sandy beaches, while others favour coral or rocky reefs.

Knowledge of the fauna

The South African chondrichthyan fauna is not well known. Compagno (2000) noted that the discovery of Southern African and South African cartilaginous fishes lagged behind those of the rest of the world, and that prior to being recorded off South Africa, wide-ranging species were usually described from other regions. There are extralimital species that include Southern African and other wide-ranging species, that may be recorded off South Africa in the future - in particular, those from the inshore tropical, deep slope, and oceanic environments. Several undescribed South African species are known, but have not been

Table 3. Distribution categories for South African cartilaginous fishes.

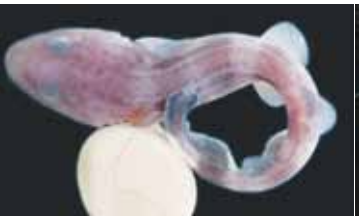
Distribution category	Nº. species	% total
Eastern Cape	1	0.6
Eastern Cape to KwaZulu-Natal	15	8.3
KwaZulu-Natal	51	28.2
Northern Cape	4	2.2
Northern and Western Cape	10	5.5
Northern, Western Eastern Cape	16	8.8
Northern Cape to KwaZulu-Natal	29	16.0
Northern and Western Cape, KwaZulu-Natal	2	1.1
Western Cape	13	7.2
Western and Eastern Cape	10	5.5
Western and Eastern Cape, KwaZulu-Natal	25	13.8
Western Cape, KwaZulu-Natal	5	2.8
Total	181	100

formally described. In addition, further exploration may reveal new undescribed species. In 1998, the deep-slope ghost catshark (*Apristurus manis*) was found off Cape Town, and was identified as such in 1999. Recently a long-standing record of the North Atlantic skate *Amblyraja radiata* was found to be based on an Antarctic and Southern Indian Ocean species, *A. taaf*, which had only been described in 1987 (M. Endicott, *pers. comm*.). A rare megamouth shark (*Megachasma pelagios*) was stranded on a beach in the Eastern Cape in 2002, and was the first specimen collected in South Africa, southern Africa, and the African continent (Smale *et al.* 2002). In retrospect, it seems obvious that our basic knowledge of the chondrichthyan fauna has increased markedly only when active interest in the ichthyofauna, and vigorous field explorations have occurred. For example, during the period in which Andrew Smith, John Gilchrist, his colleagues, and contemporary researchers were engaged in collecting specimens and examining material in systematic collections. Conversely, there was a reduction in the rate of discoveries when there was limited or no interest in the fauna or its exploration.

Table 4. Habitat categories of South African cartilaginous fishes.

Habitat category	Nº. species	% total
Oceanic	13	7.2
Continental shelves	59	32.6
Shelves, fresh-water	6	3.3
Shelves to oceanic	10	5.5
Shelves to slopes	17	9.4
Continental slopes	67	37.0
Slopes to oceanic	3	1.7
Shelves to semi-oceanic	4	2.2
Wide range in habitats	2	1.1
Total	181	100.0

Table 5 presents an estimate of how well the South African chondrichthyan fauna is known. A score of 0 is essentially unknown. Scores of 1 and 2 are intermediate and somewhat arbitrary. 3 is scored where extensive long-term sampling programs have been undertaken - such as Marine and Coastal Management's offshore




demersal surveys of the west and southeast coast hake zones, the KwaZulu-Natal Sharks Board's sampling that have yielded relatively few surprises in the last decade or two, and anglers in most parts of South Africa that intensively sample the inshore shelf from the intertidal to 50 m.

Table 5. Knowledge of South African cartilaginous fishes by habitats.

Habitat category	Ranking
Inshore (0 to 50 m)	1 to 3
Offshore (50 to 200 m)	1 to 3
Upper slope (200 to 600 m)	0 to 3
Mid slope (600 to 1200 m)	0 to 3
Lower slope (below 1200 m)	0 to 2
Epipelagic zone	0 to 2

Knowledge of the inshore (0 to 50 m) benthic and littoral chondrichthyan fauna is patchy, and areas like the Northern Cape coast are sketchily known. In contrast, the larger inshore elasmobranchs of KwaZulu-Natal - particularly large elasmobranchs that are caught in antishark nets and fished by anglers - are very well known. However, small species that can slip through the meshes of shark nets, and those that are of no interest to anglers or commercial fishers are sketchily known. Likewise, the reef-dwelling species in the far north that are not caught in shark nets are also relatively unknown. The offshore shelf (50-200 m) and upper slope (200-600 m) fauna on the West and Southwest coasts includes some of the best known demersal and epibenthic chondrichthyan faunas. In contrast, on the East Coast, the upper slope faunas are sketchily known. The middle slope between 600 to 1200 m is best known from the West coast and from limited parts of the South coast of South Africa. This is primarily a result of sampling by the *Africana*. The fauna in those areas that have not been sampled are sketchily or poorly known. Lower slope faunas below 1200 m are sketchily known on the West coast of South Africa - due to early collections by the RV *Pickle*, the current *RV Africana*, and commercial exploratory trawling and deep-set long-lining - but are poorly known elsewhere. Some wide-ranging deep slope species such as the false cat shark (*Pseudotriakis microdon*), the bigeye sand tiger (*Odontaspis noronhai*), and the smallspine spookfish (*Harriotta haeckeli*) have not been collected, but are to be expected in very deep water. The deepwater skate *Cruriraja durbanensis* was collected once by the RV *Pickle* off the Northern Cape and not seen since; while *Amblyraja robertsi* was described in 1970 from a single specimen found in the Western Cape (taken by the German research trawler, *Walter Herwig*). In the 1990s, the *RV Africana* recovered a few additional specimens from the same locality.

As elsewhere, the South African oceanic elasmobranch fauna is undiverse, and is well known to poorly known in the epipelagic zone. It is poorly known in the mesopelagic and bathypelagic zones. New records are expected for certain wide-ranging species that have not currently been recorded from South Africa, or for that matter Southern Africa. These include the bigeye sand tiger (*Odontaspis noronhai*), largetooth cookiecutter shark (*Isistius plutodus*), and spined pygmy shark (*Squaliolus laticaudus*). Pelagic long-liners have found the whitetail dogfish (*Scymnodalatias albicauda*) in the Southern Ocean well Southwest and Southeast of South Africa. It may be recorded in South African waters in the future. Some dwarf oceanic species such as the taillight shark (*Euprotomicroides zantedeschia*) and the longnose pygmy shark (*Heteroscymnoides marleyi*) are rarely found, as are the pigmy shark (*Euprotomicrus bispinatus*), cookiecutter shark (*Isistius brasiliensis*), and the semipelagic broadband lanternshark (*Etmopterus gracilispinis*). The longfin mako (*Isurus paucus*) may occur off South Africa, however confirmation is required.

In most areas, there is little knowledge of the distribution of large common offshore oceanic sharks. These include the blue (*Prionace glauca*), silky (*Carcharhinus falciformis*), oceanic whitetip (*Carcharhinus longimanus*), bigeye and pelagic threshers (*Alopias superciliosus* and *A. pelagicus*), and shortfin mako (*Isurus oxyrinchus*). In comparison with the Northern Hemisphere, there are astonishingly few offshore

records of these large pelagic sharks, and for that matter the associated pelagic stingray (*Pteroplatytrygon violacea*). What little we know of the distribution of the shortfin mako and pelagic thresher in Southern African waters is primarily from the KwaZulu-Natal shark nets. These samples are derived from individuals that occasionally wander close inshore. Important offshore commercial species such as the silky, blue, and oceanic whitetip sharks are not caught in the shark nets, and thus records are few and far between. This is an unfortunate situation, particularly when consideration is given to the intensity of epipelagic long-line fisheries in the South Atlantic and Southern Indian Ocean that are targeting scombroids, large non-batoid sharks, and the pelagic stingray (by-catch species). In addition, there is the burgeoning trade in the fins of the large pelagic sharks. Unfortunately, there have been few pelagic long-line surveys of sharks in the epipelagic zone of Southern Africa to match demersal work that has been undertaken off the West and South coast of South Africa and Namibia. The distribution of the large oceanic batoids of the Family Mobulidae (devil rays) is poorly known off South Africa. The relatively few records that exist are derived from either strandings or catches in the KwaZulu-Natal shark nets. Devil rays are rarely caught by long-lines, but were susceptible to giant pelagic gill nets during the past few decades.

The white shark (*Carcharodon carcharias*) is well-known from coastal records off the southwest and east coasts of South Africa, where it regularly occurs close inshore, but this species is poorly known north of Saldanha Bay on the west coast of South Africa, Namibia, Angola and Mozambique. In addition, it is poorly known in the epipelagic zone, which it apparently readily penetrates, as do other members of the Family Lamnidae. Such inadequate knowledge of its distribution and movements makes protecting this threatened species problematic.

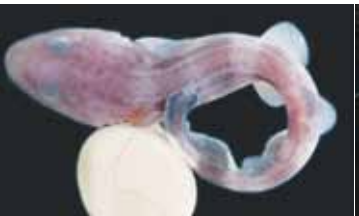
Abundance of the fauna

A simple scale of the relative abundance of South African cartilaginous fishes is presented in Table 6. *Rare* species are those with 1-10 examples collected or otherwise sampled (photographed, observed, etc.). Species that are *infrequent* are known from 10 to 100 examples; *Unabundant* species from 100 to 1000; and *Common* species from 1000 or more examples. About half (52%) of known species are rare or unabundant, while slightly more than a quarter are common (including important fisheries species). An additional category, *abundant*, might be used for those species in which more than 100 000 specimens are known, and *common* restricted to 1000 to 100000. However, the current data set is insufficient, and thus at present these categories cannot be distinguished.

Table 6. Abundance of the South African cartilaginous fishes.

Abundance Category	Nº. Species	% Total
Rare	64	35.4
Infrequent	30	16.6
Unabundant	39	21.5
Common	48	26.5
Total species	181	100.0

It is important to note that despite a high level of species diversity in the South African chondrichthian fauna, stock sizes remain relatively small. This low abundance is a function of the limited but diverse habitats that effectively compress the ranges of many species. Concomitant with the low abundance is a limited potential to sustain fishing pressure, and thus, these resources are vulnerable to over exploitation.




References

Compagno, L.J.V., 2000. An overview of chondrichthyan systematics and biodiversity in southern Africa. . Transactions of the Royal Society South Africa 1999 54, 75-120.

Compagno, L.J.V., Ebert, D.A., Smale, M.J., 1989. Guide to the sharks and rays of southern Africa. Struik Publishers, Cape Town.

Smale, M.J., Compagno, L.J.V., Human, B.A., 2002. First megamouth shark from the western Indian Ocean and South Africa. South African Journal of Marine Science 98, 349-350.

Appendix 2

Current fishing regulations pertaining to sharks

Table 1. Sharks currently listed in Annexures 4, 7 and 8 of the amended regulations of the Marine living Resources Act, Gazette No. 35903, 23 November 2012 – listings presented here only refer to sharks and rays.

Annexure	List	Common name	Species
4 & 7 – Regulation 21	Prohibited species list for commercial and recreational fishers	Leopard catshark	*Poroderma pantherinum*
		Ragged tooth	*Carcharias taurus*
		Spotted gully	*Triakis megalopterus*
		Striped catshark	*Poroderma africanum*
		Great white shark	*Carcharodon carcharias*
		Sawfishes	*Pristidae*
		Basking shark	*Cetorhinus maximus*
		Whale shark	*Rhinocodon typus*
8 – Regulation 22	Exploitable list	Elasmobranchs	*Elasmobranchii*
	Excluding	Great white	*Carcharodon carcharias*
		Leopard catshark	*Poroderma pantherinum*
		Ragged tooth	*Carcharias taurus*
		Spotted gully	*Triakis megalopterus*
		Striped catshark	*Poroderma africanum*

Appendix 3

Summary of Chondrichthyans targeted by south african fisheries and potential sources of fishery-dependent and fishery-indepenent survey data. Data reflects sharks reported by fishers or observers. Estimated catch in 2010 (t) is shown with percentages attributed to each fishery (Da silva *in prep*).

Order	**Family**	**Genus/ Species**	**Estimated catch 2010 (t)**	**Commercial linefishery**	**Recreational linefishery**	**Demersal shark longline**	**Pelagic shark longline**	**Tuna and swordfish pelagic longline**	**Gill and beach seine net fisheries**	**Offshore /inshore demersal trawl fishery**	**Small pelagic fishery**	**Hake longline fishery**	**Bather protection**	**Prawn trawl fishery**	**Fishery-dependent data**	**Fishery- independent data**
Squalo-morpha	unidentified	unidentified	**1-10**									■				
Hexanchi-formes Cow and frilled sharks	Hexanchidae Cow sharks	*Heptranchias perlo* Bonnaterre, 1788 Sharpnose sevengill shark “Sixgill”	**0**													**X**
		Notorynchus cepedianus Péron, 1807 Spotted sevengill shark “Cowshark”	**<1-10**	■	Δ										**X**	**X**
		Hexanchus griseus Bonnaterre, 1788 Bluntnose sixgill shark “Sixgill shark”	**<1**									■				**X**





Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
	Chlamydose-lachidae Frilled sharks	*Chlamydo-selachus africana* Ebert & Compagno, 2009 Southern African Frilled shark	<1							■						X
Squali-formes Bramble, sleeper and dogfish sharks	Etmopteridae Lantern shark	*Centro-scyllium fabricii* Reinhardt 1825 Black dogfish “Dogshark”	<1							■						X
		Etmopterus spp Unidentified Lantern sharks “Dogshark”	<1							¢		Δ			X	X
	Centropho-ridae Gulper shark	*Centro-phorus* spp Gulper shark “Dogshark”	<1							■						X

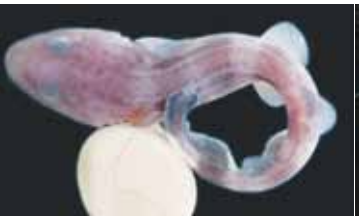



Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
		Deania spp Gulper sharks "Dogshark"	<1							■		Δ			X	X
	Somniosidae Sleeper sharks	*Centroscymnus* spp Sleeper sharks "Dogshark"	<1							■						X
	Dalatiidae Kitefin sharks	*Isistius brasiliensis* Quoy and Gaimard, 1824 Cookiecutter shark	<1							~	~				X	X
	Squalidae Dogfish sharks	*(Squalus asper)** *Cirrhigaleus asper* Merrett, 1973 Roughskin spurdog "Dogshark"	<1											■		X





Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
		Squalus acanthias Linnaeus, 1758 Piked dogfish "Dogshark"	**<1**	Δ		Δ			Δ	■					**X**	**X**
		Squalus megalops Macleay, 1881 African shortnose spurdog "Dogshark"	**11-100**							Δ		■			**X**	**X**
		Squalus mitsukurii Jordan & Snyder, 1903 Shortspine spurdog "Dogshark"	**<1**							■		Δ			**X**	**X**



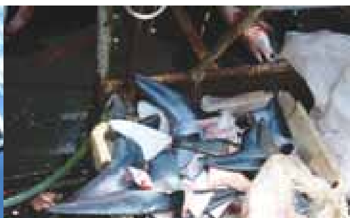

Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
Carcharhiniformes Ground sharks	Carcharhinidae Requiem sharks	*Carcharhinus amboinensis* Müller & Henle, 1839 Pigeye or Java shark "Copper shark" or "bull shark"	**<1**										■			
		Carcharhinus brachyurus Günther, 1870 Bronze whaler or copper shark	**201-300**	●	Δ	○	○	Δ	Δ		Δ		Δ	Δ	**X**	**X**
		Carcharhinus brevipinna Müller & Henle, 1839 Spinner shark "Copper shark"	**1-10**			**X**				**X**				Δ	**X**	





Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
		Carcharhinus falciformis Bibron, *In* Müller & Henle, 1839 Silky shark "Copper shark"	**1-10**				~	~		~				Δ	**X**	
		Carcharhinus leucas Valen-ciennes, *In* Müller & Henle, 1839 Bull or Zambezi shark "Copper shark"	**1-10**	○		○	○	○		Δ			○		**X**	
		Carcharhinus limbatus Valen-ciennes, *In* Müller & Henle, 1839 Blacktip shark	**1-10**	●		⊘	⊘	⊘				⊘	⊘	Δ	**X**	






Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
		Carcharhinus longimanus Poey, 1861 Oceanic whitetip shark	**1-10**				●	●						Δ	**X**	
		Carcharhinus melanop-terus Quoy & Gaimard, 1824 Blacktip reef shark	**1-10**	○		○	○	○					○	Δ	**X**	**X**
		Carcharhinus plumbeus Nardo, 1827 Sandbar shark	**<1**										■	Δ		
		Carcharhinus obscurus Lesueur, 1818 Dusky shark "Copper shark"	**11-100**	○		○	○		○			○	○	Δ	**X**	**X**





Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
		Galeocerdo cuvier Péron & Lesueur, *In* Lesueur, 1822 Tiger shark	**1-10**	~									~		**X**	
		Prionace glauca Linnaeus, 1758 Blue shark	**301-400**	**X**	Δ	Δ	□	~			Δ	Δ			**X**	**X**
		Rhizoprionodon acutus Rüppell, 1837 Milk shark	**<1**	Δ	Δ									Δ	**X**	
	Triakidae Hound-sharks, smooth-hounds, topes, gully and whiskery sharks	*Galeorhinus galeus* Linnaeus, 1758 Soupfin or tope shark	**401-500**	●	Δ	●	Δ		Δ	●	Δ	Δ			**X**	**X**

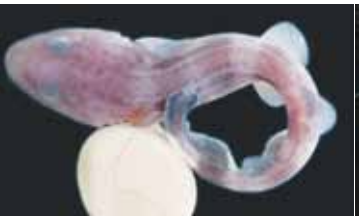



Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
		Mustelus mustelus Linnaeus, 1758 Smooth-hound shark	**300-400**	○	∆	□				○	∆	∆			**X**	**X**
		Mustelus palumbes Smith, 1957 Whitespot smooth-hound shark “Smooth-hound shark”	**11-100**	⊘		⊘				■			⊘		**X**	**X**
		Mustelus mosis Hemprich & Ehrenberg, 1899 Hardnose or Arabian smooth-hound shark “Smooth-houndshark”	**1-10**	○	○	○				●					**X**	





Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
		Triakis megalop-terus Smith, 1849 Spotted gully shark "Smooth-houndshark"	**1-10**	~								~			**X**	**X**
	Scyliorhi-nidae Catsharks	*Apristurus saldanha* Barnard, 1925 Saldanha catshark	**<1**							■					**X**	
		Halaelurus natalensis Regan, 1904 Tiger catshark	**1-10**	●						●		●			**X**	**X**
		Halaelurus lineatus Bass, D'Aubrey & Kistnasamy, 1975 Lined catshark	**<1**							■						**X**

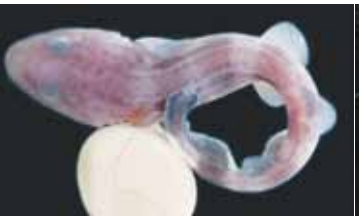



Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Tuna and swordfish	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
		Haploble-pharus edwardsii Voigt, *In* Cuvier, 1832 Puffadder shyshark	**1-10**	●		●				●					**X**	**X**
		Haploble-pharus fuscus Smith, 1950 Brown shyshark “Happy eddy”	**1-10**	●						●					**X**	
		Haploble-pharus pictus Müller & Henle, 1838 Dark shyshark	**1-10**	●						●					**X**	
		Holohalae-lurus regani Gilchrist, 1922 Izak or halaluja catshark	**1-10**							●		●			**X**	





Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
		Poroderma africanum Gmelin, 1789 Striped catshark or pyjama shark	**1-10**	~		~									**X**	**X**
		Poroderma pantherinum Smith, *In* Müller & Henle, 1838 Leopard catshark	**1-10**			~				~					**X**	**X**
		Scyliorhinus capensis Smith, *In* Müller & Henle, 1838 Yellow-spotted catshark	**1-10**	⊘		⊘				■					**X**	**X**

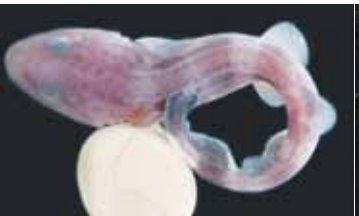



Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
	Sphyrnidae Hammer-head, bonnethead or scoophead sharks	*Sphyrna lewini* Griffith & Smith, *In* Cuvier, 1834 Scalloped hammerhead "Hammer-head shark"	**1-10**	○			○	○			○	○	○	Δ	**X**	**X**
		Sphyrna mokarran Rüppell, 1837 Great hammerhead "Hammer-head shark"	**1-10**	○			○	○					○		**X**	**X**
		Sphyrna zygaena Linnaeus, 1758 Smooth Hammer-head "Hammer-head shark"	**1-10**	○	⊘	○	⊘	○		⊘	⊘		⊘		**X**	**X**



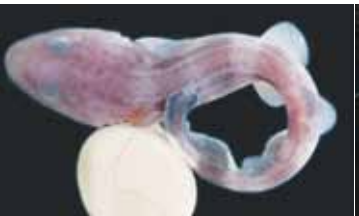


Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
Lamni-formes Mackerel sharks	Lamnidae Mackerel sharks	*Carcharodon carcharias* Linnaeus, 1758 Great white shark	**<1**										■		**X**	**X**
		Isurus oxyrinchus Rafinesque, 1810 Shortfin mako shark	**501-600**				■								**X**	**X**
		Lamna nasus Bonnaterre, 1788 Porbeagle shark	**<1**					■								**X**
	Alopiidae Thresher sharks	*Alopias pelagicus* Nakamura, 1935 Pelagic or small tooth thresher “Thresher shark”	**1-10**	○			○	○		○	○		○		**X**	




Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
		Alopias superciliosus Lowe, 1839 Bigeye thresher shark "Thresher shark"	**1-10**	○			○	○		○	○		○		**X**	**X**
		Alopias vulpinus Bonnaterre, 1788 Thresher shark	**1-10**	●			○	○	○	○	○		○		**X**	**X**
	Pseudocarchariidae Crocodile sharks	*Pseudocarcharias kamoharai* Matsubara, 1936 Crocodile shark	**1-10**				●	●							**X**	**X**
	Odontaspididae Sandtiger sharks	*Carcharias taurus* Rafinesque, 1810 Spotted ragged-tooth shark	**1-10**	○			○	○		○		○	○		**X**	**X**

Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
Pristiophori-formes Saw sharks	Pristiopho-ridae Saw fishes and saw sharks	*Pliotrema warreni* Regan, 1906 Sixgill sawshark	**1-10**							■		Δ			**X**	**X**
Squatini-formes Angel sharks and sanddevils	Squatinidae Angel sharks	*Squatina africana* Regan, 1908 African angel shark	**<1**										■		**X**	**X**
Torpedini-formes Electric rays	Torpedinidae Torpedo rays	*Torpedo fuscoma-culata* Peters, 1855 Black-spotted torpedo “Ray” or “skate”	**1-10**							■		Δ			**X**	**X**
		Tetronarce nobiliana Bonaparte, 1838 Torpedo ray “Ray” or “skate”	**1-10**							■		Δ			**X**	**X**

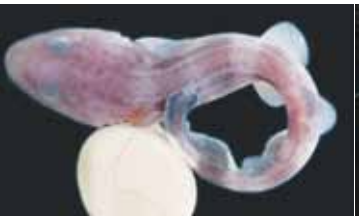



Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
		Torpedo sinuspersici Olfers, 1831 Variable or marbled torpedo ray "Ray" or "skate"	**1-10**							■					**X**	
	Narkidae Sleeper rays	*Heteronarce garmani* Regan, 1921 Natal electric ray "Ray" or "skate"	**<1**							■					**X**	**X**
		Narke capensis Gmelin, 1789 Onefin electric ray "Ray" or "skate"	**1-10**							■		Δ			**X**	**X**
Rajiformes Skates and rays	Arhyncho-batidae Softnose skates	*Bathyraja smithii* Müller & Henle, 1841 African softnose skate "Ray" or "skate"	**11-100**							■		Δ			**X**	**X**





Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
	Rajidae Hardnose skates	*Raja* spp "Ray" or "skate"	**11-100**	Δ		Δ				■		Δ			**X**	**X**
		*(Raja alba)** *Rostroraja alba* Lacepède, 1803 White or spearnose skate "Ray" or "skate"	**11-100**	~		~				~		Δ			**X**	**X**
		*(Raja caudaspi-nosa)** *Rajella caudaspi-nosa* (von Bonde & Swart, 1923) Munchkin skate "Ray" or "skate"	**11-100**							■		Δ			**X**	**X**




Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
		*(Raja confundens)** *Rajella barnardi* (Norman, 1935) Bigthorn skate "Ray" or "skate"	**1-10**							■					X	X
		*(Raja leopardus)** *Rajella leopardus* (von Bonde & Swart, 1923) Leopard skate "Ray" or "skate"	**11-100**							■						
		*(Raja linnaeus)** *Raja miraletus* (Linnaeus, 1758) Twineyed skate "Ray" or "skate"	**11-100**	Δ						■		Δ			X	X





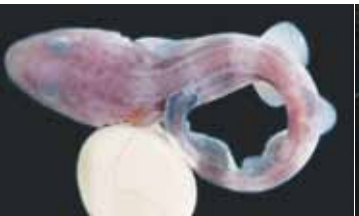
Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
		(Raja pullopunc-tata) Dipturus pullopunctata* (Smith, 1964) Slime or graybelly skate "Ray" or "skate"	**11-100**							■		∆			**X**	**X**
		(Raja ravidula) Rajella ravidula* (Hulley, 1970) Smoothback skate "Ray" or "skate"	**1-10**							●		●			**X**	**X**
		*(Raja spinaci-dermis)** *Malacoraja spinaci-dermis* Barnard, 1923 roughskin skate "Ray" or "skate"	**11-100**							■						

Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
		(Raja springeri) Dipturus springeri* Wallace, 1967 Roughbelly skate "Ray" or "skate"	**10-100**							■		Δ			**X**	**X**
		Raja straeleni Poll, 1951 Biscuit skate "Ray" or "skate"	**201-300**	Δ		Δ				■		Δ			**X**	**X**
		(*Raja wallacei)* Leucoraja wallacei* (Hulley, 1970) Yellow-spotted skate "Ray" or "skate"	**11-100**	Δ		Δ				■		Δ			**X**	**X**
	Anacantho-batidae Legskates	*Cruriraja* spp "Ray" or "skate"	**11-100**							■		Δ			**X**	**X**

Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
	Rhinobatidae Guitarfishes	*(Rhinobatos annulatus)** *Acroterio-batus annulatus* Smith, *In* Müller & Henle, 1841 Lesser sandshark or little guitarfish "Sandshark"	**11-100**	**X**	**X**	**X**			**X**	**¢**		**X**			**X**	**X**
		*(Rhinobatos blochii)** *Acroterio-batus blochii* Müller & Henle, 1841 Bluntnose guitarfish or fiddlefish	**1-10**												**X**	
		Rhinobatos holcorhyn-chus (Norman, 1922) Slender guitarfish "Sandshark"	**<1**							**■**					**X**	**X**

Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
		*(Rhinobatos leucospilus)** *Acroterio-batus leucospilus* Norman, 1926 Greyspot Guitarfish "Sandshark"	**1-10**	˜	Δ	˜									**X**	
		(Rhinobatos ocellatus)* *Acroterio-batus ocellatus* Norman, 1926 Speckled guitarfish "Sandshark"	**<1**							■						**X**
	Rhyncho-batidae Wedgefishes	*(Rhinobatos djiddensis)** *Rhyncho-batus djiddensis* (Forsskål, 1775) Giant guitarfish "Sandshark"	**<1**							■					**X**	**X**

Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
Myliobatoidei Stingrays	Myliobatidae Eagle rays	*Aetobatus narinari* Euphrasen, 1790 Spotted eagleray or bonnetray	**1-10**	Δ						■				Δ	**X**	
		Myliobatis aquila Linnaeus, 1758 Common eagle ray or bull ray “Eagle ray” or “bull ray”	**1-10**	○						□		○		Δ	**X**	**X**
		Pteromylaeus bovina Geoffroy Saint-Hilaire, 1817 Duckbill ray “Eagle ray” or “bull ray”	**1-10**	●						●		●				**X**
	Mobulidae Devil rays	*Mobula spp* Devil rays	**<1**					●		●			●		**X**	
		Manta spp Manta rays	**<1**					●		●			●		**X**	

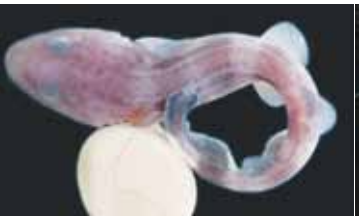



Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
	Dasyatidae Whiptail stingrays	*Dasyatis brevicau-datus* Hutton, 1875 Short-tail stingray "Ray" or "skate"	**<1**	■										Δ	**X**	**X**
		(Dasyatis kuhlii) Neotrygon kuhlii* (Müller & Henle, 1841) Blue-spotted stingray "Ray" or "skate"	**1-10**	●		●								Δ	**X**	
		Dasyatis chrysonota Smith, 1828 Blue stingray "Ray" or "skate"	**1-10**	○		○				○		○		Δ	**X**	





Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
		*(Dasyatis violacea)** *Pteroplaty-trygon violacea* (Bonaparte, 1834) Pelagic stingray "Ray" or "skate"	**11-100**				□	○		○					**X**	**X**
		Himantura cf. gerrardi Gray, 1851 Sharpnose stingray "Ray" or "skate"	**<1**	¢										Δ	**X**	**X**
		Himantura uarnak Forsskål, 1775 Honeycomb stingray "Ray" or "skate"	**<1**	¢											**X**	



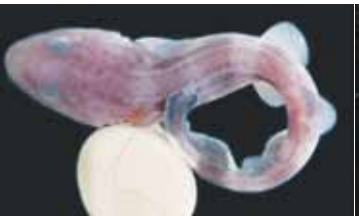

Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
		Taeniura lymma Forsskål, 1775 Bluespotted ribbontail stingray "Ray" or "skate"	**<1**	■											**X**	
	Gymnuridae Butterfly rays	*Gymnura natalensis* Gilchrist & Thompson, 1911 Diamond or butterfly ray "Ray" or "skate"	**11-100**											Δ	**X**	
Chimaeri-formes Chimaeras or silver sharks	Chimaeridae Shortnose chimaeras	*Hydrolagus* spp. Rabbitfish or chimaera "ratfish"	**<1**							■						**X**
	Rhinochi-maeridae Longnose chimaeras	*Harriotta raleighana* Goode & Bean, 1895 Narrownose chimaera	**<1**							■						**X**





Order	Family	Genus/ Species	Estimated catch 2010 (t)	Commercial linefishery	Recreational linefishery	Demersal shark longline	Pelagic shark longline	Tuna and swordfish pelagic longline	Gill and beach seine net fisheries	Offshore /inshore demersal trawl fishery	Small pelagic fishery	Hake longline fishery	Bather protection	Prawn trawl fishery	Fishery-dependent data	Fishery- independent data
		Rhinochi-maera spp	**<1**							■						**X**
	Callorhin-chidae Elephant fishes	*Callorhin-chus capensis* Duméril, 1865 St. Joseph shark	**801-900**						⊘	■					**X**	**X**
	%catch per species: ∆ <1 X 1-10 11-25	˜ 26-50 £ 51-75 ¢ 76-100														

*Species re-described (Ebert, unpublished information). Species identification remains an issue for these species however DAFF databases record both species separately, species names are shown as they appear in databases (in brackets) with new names if they have been re-described. Common names individual sharks, skates and rays are reported as are shown in quotation marks




Update and review of the NPOA for Sharks South Africa

C. da Silva[1*], C., Winker[1], H., Parker[1], D., Wilke[1], C.G., Lamberth[1], S.J., and S. E. Kerwath[1]

Abstract

South Africa has one of the most diverse shark faunas in the world and many species are caught in appreciable quantities in directed and non-directed shark fisheries. South Africa has well developed fisheries management systems for most of its fisheries and many challenges with regard to the sustainable management and conservation of sharks have already been identified and addressed in individual fisheries policies and management measures. The South African National Plan of Action for sharks (NPOA-Sharks) was finalised in 2013 and provided information on the status of chondrichthyans in South Africa and examined structure, mechanisms and regulatory framework related to research, management, monitoring, and enforcement associated with shark fishing and trade of shark product in the South African context. This information was used to identify, group and prioritize issues particular to South African chondrichthyan resources that require intervention in the forms of specific actions, associated responsibilities and time frames. It provides a guideline for identifying and resolving the outstanding issues around management and conservation of sharks to ensure their optimal, long term, sustainable use for the benefit of all South Africans. Integral to the NPOA for Sharks - South Africa was the list of issues to be addressed in terms of improving sources of data, addressing scientific knowledge on common and cryptic species and thereby improving the management of chondrichthyan fisheries. The NPOA for Sharks – South Africa is in the process of being updated and the progress in implementation is highlighted in this paper.

Keywords

NPOA for Sharks, South Africa, chondrichthyans, sharks, rays, chimaeras, target, bycatch.

1 DAFF, Department of Agriculture, Forestry and Fisheries, Private Bag X2, Rogge Bay 8012, South Africa.
* CharleneD@daff.gov.za

Introduction

The South African EEZ straddles two oceans and, if one considers the sub Antarctic Prince Edward Islands, includes all marine bio-zones, from tropical to polar. Consequently, South Africa has one of the most diverse faunas of cartilaginous fishes (Class Chondrichthyes) in the world. Southern African chondrichthyofauna include representatives from all 13 orders of cartilaginous fishes with 49 families and 111 genera (Ebert and van Hees 2015). Approximately 204 species occur in southern Africa, representing 20% of all known chondrichthyans with 117 shark, 79 batoid and 8 chimaera species and 13% of those endemic to the region (Ebert and van Hees 2015). This high level of diversity and endemism engenders South Africa's responsibility in conserving and managing sharks that occur in South African waters and protecting those that enter South African waters periodically.

The Department of Agriculture, Forestry and Fisheries (DAFF) is the lead governmental agency responsible for the management of sharks caught in South African fisheries. Fisheries Management is legally mandated to manage sharks in terms of the Marine Living Resources Act (MLRA), 1998 (Act No 18 of 1998) and the Regulations promulgated thereunder. Although a living copy of the National Plan of Action (NPOA) for Sharks South Africa remained in draft form for 13 years the original document formed the foundation of research and management initiatives in South Africa.

A thorough overview of chondrichthyans caught as target and by-catch in South African fisheries is provided in da Silva *et al*. (2015). A total of 100 out of 204 chondrichthyan species that occur in southern Africa are impacted by diverse fisheries ranging from recreational angling to industrialised fishing such as trawl and pelagic longline. Total reported dressed catch averaged at 3000 t between 2010 and 2012 with two-thirds of reported catch caught as bycatch (da Silva *et al.,* 2015). The most recent collated reported dressed catch of chondrichtyes in South Africa was 2300 t in 2016 (DAFF, unpublished catch data). Regulations aimed at limiting chondrichthyan catches, coupled with species-specific conditions currently exist in the following fisheries: demersal shark longline, large pelagic longline, recreational line and beach-seine and gillnet fisheries. Limited management measures are currently in place for chondrichthyans captured in other fisheries.

In 2013 the NPOA for Sharks was completed with the goal to move towards effective conservation and management of sharks that occur in the South African EEZ to ensure their optimum, long-term, sustainable use for the benefit of all South Africans, including present and future generations. The NPOA-Sharks recognized the need to determine and implement harvesting strategies consistent with the principles of biological sustainability, attained through scientifically based management and consistent with a Precautionary Approach. The NPOA for Sharks, South Africa is in the process of being updated with the intention of completion by 2019. This paper aims to highlight the implementation progress as listed in the action table produced in the NPOA for Sharks, South Africa (2013).

Status of Implementation of the NPOA for Sharks South Africa

The status of implementation of the NPOA for Sharks South Africa is listed in Table 1 in terms of an action table with clear goals, responsibilities, priorities and time-frames. The action table was divided into the following issue clusters; *data and reporting*, *classification and assessment of shark species*, *sustainable management*, *optimum use*, *capacity and infrastructure*, *compliance* and *regulatory tools.* In order to quantify progress made in each issue cluster and within each issue, significant progress was scored as 1 while partial progress was scored as 0.5.

Data and reporting involved all processes relating to improving data from fisheries-dependent and –independent sources (Table 1). This included improved identification of sharks from fishers in logbooks, collection of fisheries independent data by observers, improving understanding of total catch and discards across fisheries. Progress was made in 44 % of all listed actions. The most significant improvement in this issue cluster involved a review of catch data from all fishing sectors of all chondrichthyans caught as by-catch and target in South

African fisheries. This provided a framework for management and further research needs. A number of other actions was completed including the development of an identification guide which includes all 100 sharks, rays and chimaeras impacted by fisheries. Furthermore, development of factors for converting dressed weights of commercially valuable sharks such as smoothhound sharks *Mustelus mustelus* and tope shark (locally referred to as tope shark) *Galeorhinus galeus* was completed Although a national observer programme has not yet been re-established, Some fleets, namely the foreign-flagged large pelagic tuna longline fleet and the mid-water trawl fishery targeting Cape horse mackerel *Trachurus capensis* are subjected to 100% observer coverage.

The issue cluster; *classification and assessment of shark species* listed the National research needs such as clarification of taxonomic uncertainty, investigation of stock delineation, gaps in knowledge of life history, uncertainties related to unknown movement across RFMO and national boundaries, ecosystem changes induced by fishing and lack of formal assessments for sharks, rays and chimaeras impacted by South African fisheries (Table 1). Progress was made in 84% of all listed actions. Most notable achievements in this issue cluster include the preliminary stock assessments for tope and smoothhound sharks and the implementation of an IUCN Red List support tool applied to 21 species of sharks, rays and chimaeras.

Preliminary stock assessments of smoothhound and tope sharks were completed by the Linefish Scientific Working Group Task Team in August 2017. The assessment input data included standardized abundance indices from South African demersal trawl surveys(1990-2015) and catch estimates from the demersal trawl fishery, demersal shark longline fishery and the commercial linefishery, which were disaggregated by species and scaled up from dressed to total weights.. The Bayesian State-Space Surplus Production Model 'JABBA' (Just Another Bayesian Biomass Assessment; Winker et al. 2018) was applied to fit the catch and abundance time series of smoothhound and tope sharks. According to the initial reference case for smoothhound sharks, there is a 58.0% probability that current harvest rates are unsustainable. To allow rebuilding of the stock, total catches would need to be substantially reduced to prevent the stock from declining further below unsustainable levels. For tope shark, the reference case model predicted an 89.8% probability that the stock is overfished and that overfishing is occurring. To halt the decline and allow rebuilding of the stock total catches would need to be sustain reduced from more than 300 t to under 100 t.

In addition to the assessments on smoothhound and tope, trend analyses for Chondrichthyan species off the south and west coasts of South Africa was completed as part of a workshop hosted by IUCN Shark Specialist Group. A total number of 21 species of sharks, batoids and chimaeras were assessed including the following species caught as bycatch and target in South African fisheries in excess of 10 t; smoothhound sharks, tope sharks, yellow-spot skate *Leucoraja wallacei*, slime skate *Dipturus pullopunctatus*, twin-eye skate *Raja ocellifera*, spearnose skate *Rostroraja alba*, biscuit skate *Raja straeleni* and St. Joseph shark *Callorhinchus capensis*. The target species tope shark was classified as Endangered according IUCN Redlist criteria, which corroborates the pessimistic stock assessment results for this species. Smoothhound sharks, being the other main target species of the fishery, were classified as Least Concern, which can be largely attributed to the more resilient life history charactistics and thus short generation length and potential recovery times. Of the fairly common bycatch species twin-eye skate and yellow-spot skate were classified as Endangered and Vulnerable, respectively, while the remainder of species was Least Concern.

The issue cluster *sustainable management* related to the lack of formal management protocols across all fisheries and lack of coordination between fisheries management units (Table 1). Assessments listed above will be used in the future to address specific species such as smoothhound and tope sharks caught across multiple fisheries as listed in da Silva *et al.*, 2015. Progress was made in 50 % of all listed actions. Lack of co-ordination between separate units researching species impacted by specific fisheries and their associated management unit and others remain an issue. For example a management protocol aimed at reducing catches of smoothhound and tope would require the involvement and participation of Scientific and Management Working group of three separate fisheries; the commercial linefishery, the trawl fishery and the demersal shark longline fishery.

Further improvements towards sustainable management involved the addition of a number of CITES Appendix II species to the prohibited catch lists on permit conditions of all fisheries such as thresher sharks *Alopias* spp, hammerhead sharks *Sphyrna* spp, porbeagle sharks *Lamna nasus*, silky sharks *Carcharhinus falciformis* and oceanic white tip shark *C. longimanus*. In addition, dusky sharks *C. obscurus* were added as prohibited species list due to their similarity to silky sharks.

The issue cluster *optimum use* involved research related to the concern around the health risks associated with shark meat consumption, mitigation measures for unwanted by-catch, full utilization of shark catches and traceability of shark products from catch to sale (Table 1). Progress was made in 85 % of all listed actions. Several DAFF collaborations with SA institutions resulted in a number of studies investigating the heavy metal accumulation and toxicity of several marine fishes including sharks (Bosch *et al*., 2016a; Bosch *et al.,* 2016b). In addition a study by McKinney *et al*., 2016 investigated the health implications of consumption of sharks from the east coast of South Africa. These studies in addition to low reported catches (<10 t on average over five years) formed the basis of removing broadnose sevengill cow sharks *Notorynchus cepedianus* as a permitted species in the demersal shark longline fishery and an introduction of a slot limit on the catch of inshore demersal sharks of between 70 and 130 cm total length. Lastly, with the aim of full utilization of sharks as noted under the NPOA for Sharks South Africa the large pelagic tuna fleet was required as of 2017 to land sharks with fins naturally attached.

The issue cluster *capacity and infrastructure* which involves lack of awareness, lack of capacity to complete frequent assessment and lack of funding to outsource scientific projects. This issue cluster remains an issue and will continue to be a priority in the NPOA for Sharks South Africa (Table 1). Progress was made in 50 % of all listed actions.

Similarly, the issue clusters *compliance* and *regulatory tools* remains outstanding issues (Table 1). However, recent collaborations between DAFF, SA CUSTOMS, TRAFFIC SA and Endangered Wildlife Trust SA (EWT) has resulted in an increased awareness of trade of chondrichthyes with increased confiscations of illegal shark product. Progress was made in 100 % of all listed actions for *compliance* and 0% for *regulatory tools*.

Conclusion

The progress made in line with the NPOA for Sharks South Africa implemented in 2013 is broadly summarised in Table 1. Progress was made in six of the seven *Issue Clusters* and within most 22 issues highlighted in the NPOA Sharks SA. Most notable progress was made within the *optimum use* (100% of listed actions completed) and *classification and assessment of species* (84% of listed actions completed) issue clusters. These achievements can be attributed to the increased research capacity within DAFF SA and an increase in research institutions conducting research on sharks caught by fisheries. Progress was mostly focused in priority species that were identified through scientific working groups due to their high capture rates across multiple fisheries or availability of data. This research will be extended to more species of chondrichthyans in the future where possible. Issues and Actions where least progress was made included *sustainability and management* (50% of listed actions completed), *capacity and infrastructure* (50% of listed actions completed), *data and reporting* (44% of listed actions completed) and *regulatory tools* (0% of listed actions completed). Limited progress within these issue clusters are related to a lack of remaining capacity in enforcement and compliance, attrition of government funding which has resulted in a limited observer programme focused on a few fisheries. Lastly, lack of progress within these clusters were also related to the attrition of skilled resource managers and coordination of management of chondrichthyans caught across multiple fisheries. Although least progress was made within the issue cluster *regulatory tools*, this was mostly related to the lack of assessments. Assessments conducted within the current previous period will be used to develop regulatory tools and operational management plans in the future. The update and implementation of the NPOA for Sharks SA has been identified as a priority within the 2018/2019 calendar year.

References:

Bester-van der Merwe, A.E., Bitalo, D., Cuevas, J.M., Ovenden, J., Hernández, S., da Silva, C., McCord, M. and Roodt-Wilding, R. 2017. Population genetics of Southern Hemisphere tope shark (*Galeorhinus galeus*): Intercontinental divergence and constrained gene flow at different geographical scales. *PloS one*, 12(9), p.e0184481.

Bitalo, D.N., Maduna, S.N., da Silva, C., Roodt-Wilding, R. and A.E. Bester-van der Merwe. 2015. Differential gene flow patterns for two commercially exploited shark species, tope (*Galeorhinus galeus*) and common smoothhound (*Mustelus mustelus*) along the south–west coast of South Africa. *Fisheries research*, 172:190-196.

Bosch, A. C., O'Neill, B., Sigge, G. O., Kerwath, S. E., & Hoffman, L. C. 2016a. Heavy metal accumulation and toxicity in smoothhound (*Mustelus mustelus*) shark from Langebaan Lagoon, South Africa. *Food chemistry*, 190: 871-878.

Bosch, Adina C., Bernadette O'Neill, Gunnar O. Sigge, Sven E. Kerwath, and Louwrens C. Hoffman. 2016b. Heavy metals in marine fish meat and consumer health: a review. *Journal of the Science of Food and* Agriculture 96 (1): 32-48.

da Silva, C., Booth, A., Dudley, S., Kerwath, S., Lamberth, S., Leslie, R., Zweig, T. 2015. The current status and management of South Africa's chondrichthyan fisheries. *African Journal of Marine Science*, 37(2): 233–248.

da Silva, C., Kerwath, S. E., Wilke, C. G., Meyer, M., and S.J. Lamberth, 2010. First documented southern transatlantic migration of a blue shark *Prionace glauca* tagged off South Africa. *African Journal of Marine Science*, 32(3), 639-642.

Ebert, D. A., & Van Hees, K. E. 2015. Beyond Jaws: rediscovering the 'lost sharks' of southern Africa. *African journal of marine science*, 37(2): 141-156.

Kuguru, G., Maduna, S.N., da Silva, C., Gennari, E., Rhode, C., and A.E Bester-van der Merwe. 2018. DNA barcoding of chondrichthyans in South African fisheries. *Fisheries Research*. 206: 292-295.

Maduna, S.N., Rossouw, C., Da Silva, C., Soekoe, M. and A.E. Bester-van der Merwe. 2017. Species identification and comparative population genetics of four coastal houndsharks based on novel NGS-mined microsatellites. *Ecology and evolution*. 7(5):1462-1486.

Maduna, S. N., da Silva, C., Wintner, S.P., Roodt-Wilding, R., and A. E. Bester-van der Merwe. 2016. When two oceans meet: regional population genetics of an exploited coastal shark, *Mustelus mustelus*. *Marine Ecology Progress Series* 544: 183-196.

Parker, D., da Silva, C., and S.E. Kerwath. 2017. Data reporting challenges associated with spanning across the IOTC/ICCAT boundary: a case study of shortfin mako *Isurus oxyrinchus.* IOTC-2017-WPDCS13-14

Veríssimo, A., Sampaio, I., McDowell, J. R., Alexandrino, P., Mucientes, G., Queiroz, N., da Silva, C., Jones, C.S. and L. R. Noble. 2017. World without borders—genetic population structure of a highly migratory marine predator, the blue shark (*Prionace glauca*). *Ecology and evolution* 7(13): 4768-4781.

Winker, H., Carvalho, F. and Kapur, M. 2018a. JABBA: Just Another Bayesian Biomass Assessment. *Fisheries Research*.

Winker, H., Sherley, R., da Silva, C., Leslie, L, Attwood C.G., Sink, K., Parker, D., Fairweather, T., Swart, L. 2018b. A Red Listing support tool applied on sharks, rays, and chimaeras (chondrichthyans) abundance indices from South African demersal trawl surveys. Sub-equatorial African endemics IUCN Shark Specialist Meeting: Grahamstown, 23-26th April 2018.

Winker, H., Carvalho, F., Sharma, R., Parker, D., and S.E. Kerwath, S. 2017a. Initial results for North and South Atlantic shortfin mako (*Isurus oxyrinchus*). Stock assessments using the Bayesian surplus production model JABBA and the catch resilience method CMSY. *Collect. Vol. Sci. Pap. ICCAT,* 74(4), 1836-1866.

Winker, H., Carvalho, F., Kapur, M., Parker, D., and S.E. Kerwath. 2017b. JABBA goes IOTC: Just Another Bayesian Biomass Assessment for Indian Ocean blue shark and swordfish. IOTC-2017-WPM08-11 Rev 1.

Table 1. Review of the National Plan of Action for Sharks South Africa 2013 indicating responsibilities, time-frames and progress

Issue cluster	Issue	Description	Fishery sector	Action	Respon-sibility	Priority	Time-frame	Progress
Data and reporting	Shark species identification and reporting	In catch statistics, sharks are often lumped into generic categories.	All Fisheries excluding the KZN bather protection program	Create identification guide for chondrichthyes	FR	Immediate	1	Identification guide for 100 sharks, batoids and chimaeras caught in SA fisheries completed and circulated
				Develop permit conditions	MRM	Immediate	1	Permit conditions of various fisheries require species specific identification of catch
				Education and Implementation	MRM Working Groups	High	2	As above
				Review progress	FR and MRM	Medium	3-4	No progress
	Observer coverage	There is currently no observer coverage except for the foreign flagged pelagic tuna longline fleet.	All sectors	Re-establish, re - assess and expand observer coverage	FR	Immediate	1	Not re-established across all fisheries, but large improvement at biggest impact fishery (Large Pelagic Longline)
		Observer programmes do not collect data that are adequate to assess impact of fishing on species that are not landed.	All sectors	Define and set sampling requirements per fishery sector	FR	Immediate	1-2	Completed for some fisheries, but observer programme has not yet been implemented across all sectors
				Initiate new sampling strategy	FR	High	2-4	Sampling strategies and requirements drafted for future observer programme

	Discharge monitoring	Discharge of fish is only monitored in selected fisheries. Catch reporting is not verified.	Offshore trawl, traditional linefish, tuna pole,	Review discharge monitoring coverage and quality of information	FR, MCS	High	1-2	No progress
				Establish additional discharge monitoring requirements	FR and MCS	High	2-3	Completed for some fisheries, but observer programme has not yet been implemented across all sectors
	Reporting of directed catch and "joint product'"	Directed catches of sharks are only reported for commercial sectors.	Recreational linefish	Develop and implement a land based monitoring program expanding coverage	FR	High	1-2	Not implemented yet
		Landed catch is not weighed	Line, net fish and recreational linefish	Instigate monitoring of landings	FR, MRM and MCS	Medium	2-4	Not implemented yet
		There is no mandatory reporting	Recreational fishery	Engage with recreational initiative for web-based catch recording	FR and Recreational MRM Working Group	Medium	2-4	Web based reporting exists for some angling competitions
		There is no routine collection of length	All except Large Pelagic longline	Set target for observer coverage	FR	High	1	Observer programme not fully re-established across all fisheries, but large improvement at biggest impact fishery (Large Pelagic Longline).

		frequencies and conversion factors do not exist for most species.		Develop morphometric relationships to allow for conversion factors	FR	High	1-2	Conversion factors completed for *M. mustelus* and *G. galeus*. International morphometric relationships used for blue sharks. Length frequency data collected from landing sites and factories sporadically and out of date
		Shared stocks	All fisheries	Identify overlaps	FR and MRM	High	1-2	Overlaps in catch between fisheries identified in da Silva *et al.* 2015 Satelite tagging studies underway for shortfin mako and blue sharks
				Engage with neighbouring countries and set-up data sharing agreements	MRM	Medium	3-4	Data sharing agreements between neighboring countries non-existent
	Estimation of discards	Unable to quantify total shark mortality associated with by-catch fisheries	All fisheries	Identify short falls	FR	High	1	Completed (da Silva *et al*., 2015)
				Develop monitoring procedures and implement through observer programme	FR	High	1-3	Implemented in some fisheries (Longline, Midwater Trawl – 100% coverage)
Classification and assessment of shark species	Gaps in taxonomy	Taxonomical classification is uncertain for a number of shark species	All fisheries that catch rays, skates and deepwater shark species	Reclassification of all rays, skates and deepwater shark species using genetics and morphometrics (Barcoding of Life Programmes)	FR	Immediate	Ongoing	Taxonomic revision of known SA species: Currently being completed by DAFF and Pacific Shark Centre Genetics research: Substantial headway was been made with DNA barcoding/ molecular species identification of some taxonomic challenging groups e.g. catsharks and

								houndharks (Maduna *et al.*, 2017; Kuguru *et al.*, 2018) ** Priority for future would be how to address these changes in the various historical databases
	Stock delineation	There are several stocks that might be genetically distinct to areas in SA, while others are appear to be shared with other countries.	All fisheries	Collection of additional genetic material through national research surveys and observer programme	FR	Medium	Ongoing	Completed for top four commercial species (Maduna *et al.*2016; Bitalo *et al.,* 2016; Veríssimo *et al.* 2017; Bester-van der Merwe *et al.*, 2017)
	Gaps in the knowledge of life history	For many species, basic information on life history i.e. age and growth and reproductive capacity is not available or fragmented.	All fisheries	Gap analysis example South African marine status reports	FR	Immediate	1	Gap analysis completed with updated available life-history information for all 100 chondrichthyes targeted or caught as by-catch in SA Fisheries. Life-history parameters available for 15 species, mostly published in grey-literature.
				Prioritise species	FR	High	1	Initial species selected included the top 4 species caught in target fisheries. ** this needs to be updated for 100 species of chondricthyes impacted by SA fisheries.
				Source research capacity i.e. students	FR	High	1	Ongoing, currently working with UCT and Stellenbosch. Funding limitations persist.

				Collect and work up biological material from national research surveys and observer programme	FR	High	1-3	Completed where possible.
	Spatio-temporal behaviour	Information gaps exist around spatio-temporal behaviour i.e. identification of nursery and mating areas for live-bearing sharks.	All fisheries	Reference gap analysis	FR	Immediate ** changed to ongoing depending on species selected for next period	1	Geostatistical models completed for 21 species from biomass indices from SA demersal trawl surveys: (Winker *et al.*, 2018b) Impact of RFMO management boundaries investigated (Parker *et al.*2017). CPUE standardization by area completed for pelagic shark longline fishery and demersal shark longline fishery. Nurseries for pelagic sharks investigated (da Silva *et al.*, 2010): Suspected shortfin mako nursery off Agulhas Bank shelf edge currently being investigated. Satellite tagging fieldwork completed. Studies in prep for smooth hammerhead *Sphyrna lewini* with initial results showing spatial and temporal variation (Kuguru *in prep*.) Raggedtooth *Carcharias taurus* shark project showing philopatric behavior

								along the Eastern Cape/ KZN Coast (Klein *et al.* in prep.).
				Prioritize species	FR	High	1	Research focused on top chondrichthyes caught in fisheries
				Source research capacity i.e. students	FR	High	1	Ongoing. Most of the progress so far have been through student projects.
				Collect and work up biological material from national research surveys and observer programme	FR	High	1-3	Ongoing. Most of the progress so far have been through student projects.
	Ecosystem changes induced by fishing	Habitat alteration through Fishing activities i.e. pupping grounds of demersal sharks.	Inshore and offshore trawl	Engage with EcoFish project that is investigating the trawl effects of the benthos	FR ** change to DEA	Medium	ongoing	Spatial conservation plan is being developed by the Department of Environmental Affairs
		Cascading effects on the ecosystem by the removal of apex predators	All fisheries	Ecosystem modeling using ecosym and ecopath	FR	Low	Ongoing	No specific research conducted.
	Lack of formal assessments	Only two of the 98 species have been assessed, a	All fisheries	Prioritize species for assessment	FR	High	1-2	Assessments completed for 22 species of chondrichthyes. (Winker *et al.,* 2018b)

		further 14 species were assessed for the KZN region.						Preliminary assessment of smoothhound shark and tope shark completed in 2017. Contribution to RFMO assessments such as shortfin mako sharks; (Winker *et al.*, 2017a) and blue sharks; (Winker *et al.,* 2017b)
				Identify suitable assessment models	FR	High	1-4	As above.
				Collect and collate relevant material	FR	High	1-4	Ongoing
				Undertake assessments	FR	High	1-4	As above.
Sustainable management	Lack of formal management protocol for target and "joint product species"	Two species were assessed in terms of a per- recruit and an ASPM, respectively, according to the available data. There is no formal protocol on assessments and recommendations in any of the fisheries.	All fisheries	Develop management protocol	FR and MRM	High	1-2	No protocols have been formalized yet
				Implement management protocol	FR	Medium	2-3	As above.
				Management action based on protocol	MRM	Medium	2-4	Management so far has been *ad hoc*., when required, but several management actions have been implemented in several fisheries <u>Large Pelagic Longline Fishery:</u> • The following CITES Appendix II species are prohibited: 1) Silky sharks *Carcharhinus falciformis* 2) Oceanic white tips *C. longimanus*

								3) Thresher sharks family Alopiidae 4) Porbeagle sharks *Lamna nasus* 5) Mobulid rays 6) Hammerhead sharks family Sphyrnidae • In addition: dusky sharks *C. obscurus* are prohibited • Purse seine fishing and Fish Aggregating Devices (FADs) for tuna and tuna-like species prohibited in SA • The release of unwanted or prohibited species is encouraged as per permit conditions. • Observers are required to report capture and release of all species, including information on release conditions • Fins may not be removed from shark trunks as per permit conditions <u>Demersal Shark Longline Fishery</u>: • Retention of CITES Appendix II species listed above prohibited • Retention of broadnosed sevengill cow sharks prohibited • Slot limit for commercially valuable shark species (tope and smoothhound shark) of 70 – 130 cm currently in the process of being implemented • No fishing north of the Kei River due to an increase in shark biodiversity

								<u>Beach-seine and gillnet fisheries:</u> • No retention of sharks and rays with the exception of beach-seine fishers in False Bay <u>Demersal inshore trawl:</u> • No by-catch restrictions but move-on rules apply to avoid high teleost and chondrichthyan catches <u>Recreational linefishery:</u> • 1 individual of each shark species per day may be retained with the exception of the following species: 1) White shark *Carcharodon carcharias* 2) Basking shark *Cetorhinus maximus* 3) Whale sharks *Rhincodon typus* 4) Sawfish family Pristidae
	Lack of coordination of shark fishery management	Most sharks are caught by more than one fishery. Currently there is no formal mechanism for shark management across	All fisheries	Review fisheries and non-extractive impacts on sharks	MRM	High	1	Completed the fisheries impact (da Silva *et al.*2015). Non extractive impacts covered by shark Biodiversity Management Plan (BMP)
				Integrate into management protocol	MRM	High	1-2	Communication improved however formal integration is still a priority

		fisheries. Furthermore, no formal mechanism to consider non-extractive use i.e. tourism. Inter-sector conflict		All fisheries that involve sharks take the NPOA into account during the development and implementation of species specific management plans	MRM	High	4	Progress restricted to select fisheries
Optimum use	Concern around health risk of shark meat consumption	High levels of heavy metal contamination are suspected for many top predators, including most shark species, making them potentially unsafe for human consumption.	All fisheries	Collect material from national research surveys and observers for priority species	FR	Medium	1-2	Research conducted by DAFF and SA institutions used in developing permit conditions (Bosch *et al.*, 2016a; Bosch *et al.*, 2016b. McKinney *et al.*, 2017) Permit conditions for the removal of broadnosed sevengill cow sharks from demersal shark longline permit conditions and the introduction of the slot limit for commercially valuable demersal shark species
				Analyze data	FR	High	1-2	As above
				Minimize catch as a safety precaution	FR and MRM			As above

	Lack of knowledge or mechanisms to reduce fishery mortality	Mitigation measures for unwanted species Proper release protocols for unwanted by-catch	All fisheries	Review existing mitigation measures	FR	Medium	2-4	Restrictions implemented in several fisheries to reduce fishing mortality
				Develop best practice release protocols per fishery	FR	Medium	2-4	Completed for Longline fisheries
				Incorporate best practice release protocols into Permit conditions	MRM	Medium	2-4	Completed for Longline fisheries
	Retained sharks are not fully utilized	Finning. Dumping of carcasses, killing of unwanted by-catch, no by-catch mitigation. There is no investigation into value adding and development of products i.e. shark leather etc. Large sharks are caught for fins and fillets not utilized.	All fisheries	International review of potential shark products	FR			New permit conditions for the Large pelagic longline fishery: Fins naturally attached as of 2017/2018
				Engage Technicons and Universities to develop possible shark products, meat as well as leather and Review possible Pharmaceutical products	FR and MRM	Medium	2-4	No progress
				Engage with relevant sections within DAFF regarding developing alternate livelihoods through full	MRM	Medium	2 weeks	No Progress

				utilization of shark products ie. Leather, markets for unwanted low value species such as St. Joseph sharks				
	Traceability of shark products from catch to sale	Product names cannot be matched with species names i.e. generic white fish	All fisheries	Introduce standardization of product codes/names	SASSI	High	1-2	South African Seafood naming standard Gazetted. Comments closed in February 2018. Builds onto existing legislation requiring mandatory generic and specific names when trading marine species
		Custom HS codes only reflect generic sharks and not the individual species.		Engage with Customs to review product codes for export/import	MRM/Traffic	High	1-3	As above.
		Fillet identification is a problem	All Fisheries	Review of genetic coding tools.	FR Traffic	Medium	2-3	Collaboration with Stellenbosch University genetics group to develop forensic laboratory. Proof of concept published (Kuguru *et al.*2018) Genetic identification method tested/ optimized on confiscated shark fins

		Fins cannot always be identified to species level Illegal recreational sale		Fin identification guide	Research	Medium	2-3	As above. Training ongoing and organized by PEW foundation. Collaboration in place with WWF TRAFFIC SA to undertake extensive training
Capacity and infrastructure	Lack of awareness	Lack of awareness and education to change misconceptions about sharks and shark fisheries Fishery pollution eg. discard of bait box packaging	All fisheries	Determine requirements for educational material	Research and Management	Medium	2-3	** This should be an NGO / NPO activity
				Implement training and awareness program	Management	Medium	3-4	Attrition in government funding and posts
				Ensure compliance with permit conditions	Compliance and Management	High	1-2	Little progress due to other priority issues within SA fishery compliance
				Develop responsible fisheries programs pertaining to sharks	DAFF	Medium	3-4	Limited progress through WWF and the South African Shark Conservancy (SASC)
	Lack of capacity	Lack of scientific capacity to timeously complete assessments and biological analysis		Develop departmental capacity and where necessary outsource shortfalls	DAFF	High	1-2	Capacity issues improved through employment of new scientists in the Large Pelagics and Sharks section

		Representation at shark international scientific working groups and stock assessment working groups of relevant RFMO	Large Pelagic Fishery	Shark expert from Fisheries Research attend relevant meetings	DAFF	Immediate	Ongoing	Increased representation of DAFF researchers at International Scientific Working group meetings, notably IOTC, ICCAT and CCSBT
	Lack of funding	Funding for shark fisheries directed research and management is therefore limited		Explore funding opportunities from International agencies.	DAFF	Medium	2-3	Participation in large scale research programmes through RFMOs
Compliance	Lack of enforcement	Finning of pelagic sharks Inability to identify shark species Recreational sale of commercially valuable shark species Exceeding recreational bag limits Interpretation and knowledge of	All Fisheries	Develop of a monitoring and enforcement strategy	DAFF: compliance with input from research and management	High	1-2	Identification guides developed that includes legislation and permit conditions for each of the 100 species impacted by fisheries

		permit conditions pertaining to sharks						
Regulatory Tools	Inadequate regulatory reference to sharks	Shark fishing competitions are not regulated adequately Fisheries specific permit conditions pertaining to sharks are not informed by overarching regulatory frameworks	All Fisheries	Review and develop regulatory tools	Legal with input from Research and Manage ment	Immediate	1	No progress due to attrition of staff within DAFF, scarcity of skilled resource managers and lack of assessments.

Review of the South African National Plan of Action for the Conservation and Management of Sharks

Compiled by the Shark Expert Panel as appointed by the Honourable Minister, Ms Barbara Creecy, Department of Environment, Forestry and Fisheries

October 2020

Executive summary

In May 2020, following public concern about shark populations along the South African coast, the Minister of Environment, Forestry and Fisheries, Ms Barbara Creecy, appointed an Expert Panel to formally review South Africa's National Plan of Action for the Conservation and Management of Sharks (NPOA-Sharks). The Panel scrutinised 60 documents over three months and held eight virtual meetings to review the NPOA-Sharks. The Panel reviewed the 62 actions of the current NPOA-Sharks and provided scores and comments for each action. The systematic review focussed on alignment with the International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks) of the Food and Agricultural Organisation (FAO), recommendations on the overall structure, completeness of the plan and identification of gaps, achievability of the plan, clarity of the actions and indicators and areas of general progress or lack of progress. The Panel also noted stakeholder concerns around the disappearance of white sharks from several aggregation sites, declines in abundance of demersal sharks, a perceived lack of habitat protection and spatial management for sharks, conflicts among shark tourism and fishing industries, and concerns related to the shark fisheries. The Panel deliberated on and drafted responses to written stakeholder input.

The Panel commended the external review process of the NPOA-Sharks as a unique example of accountability and transparency, and emphasised the Department's commitment to conserve shark species and properly manage their long-term sustainable use. The Panel agreed that the South African NPOA-Sharks was in line with international standards and covered all goals of the IPOA-Sharks as set out by the (FAO). The external experts agreed that the NPOA-Sharks is comprehensive, albeit too ambitious in both extent and timeframes. The external experts commended the progress that has been made and that is underway to implement the plan, given existing human capacity, funding and infrastructure constraints.

The Panel scores for the individual actions associated with issue clusters revealed good progress in the cluster with the foundational areas around *taxonomy* and *assessment*, and that in this context, South Africa's plans and achievements were rated by the international experts as being of the standard of developed countries such as the USA or Australia. Moderate progress was made around *optimal utilisation, capacity and infrastructure development* and *compliance*, and limited progress in *data and reporting, sustainable management* and *development of regulatory tools*. The Panel highlighted that better communication and coordination is needed within the Department, and between the Department and external stakeholders, to improve and report on some of the actions. The actions of the NPOA-Sharks should be further prioritised and their completion tracked through measurable indicators and timelines.

The Panel identified five improvement priorities:

1. Ensure effective communication and coordination from science to policy to achieve the actions of the NPOA-Sharks.
2. Develop and implement measurable indicators to track the progress and completion of actions.
3. Incorporate ecosystem effects of fishing and spatial management measures in future plans.
4. Strengthen the focus on addressing illegal, unregulated and unreported fishing and improved monitoring, surveillance and enforcement of compliance.
5. Integrate and modernise data collection and storage to improve access for future assessments.

The Panel drafted a new action table for the NPOA-Sharks in line with the analyses and recommendations emerging from the review and this table provides the nucleus for an updated NPOA-Sharks with further prioritised actions. The Panel recommended that the results of this report be presented and widely communicated to internal and external stakeholders for their input, such that the updated NPOA-Sharks becomes an inclusive roadmap for effective science, management and compliance for shark fisheries in South Africa.

Table of Contents

1. Background and terms of reference (ToR)

In May 2020, following concerns from the public on the status of some of South African shark populations, the disappearance of white sharks from some established aggregation areas and associated conflicts between fishers and tourism operators, the Honourable Minister of Environment, Forestry and Fisheries, Ms Barbara Creecy, appointed an Expert Panel to formally review the management and conservation plan of sharks, rays and chimaeras for South Africa. As such, the Panel was tasked with providing an independent and critical appraisal of the South African National Plan of Action for the Conservation and Management of Sharks (NPOA-Sharks). The NPOA-Sharks was developed in line with the International Plan of Action for the Conservation and Management of Sharks (IPOA), developed by the FAO Committee on Fisheries (1998), and within the framework of the Code of Conduct for Responsible Fisheries to which South Africa is a signatory. The NPOA-Sharks was implemented in 2013 and internally reviewed in 2018.

The aims of the IPOA-Sharks (www.fao.org) are to:

1. Ensure that shark catches from directed and non-directed fisheries are sustainable
2. Assess threats to shark populations, determine and protect critical habitats and implement harvesting strategies consistent with the principles of biological sustainability and rational long-term economic use
3. Identify and provide special attention, in particular to vulnerable or threatened shark stocks
4. Improve and develop frameworks for establishing and coordinating effective consultation involving all stakeholders in research, management and educational initiatives within and between States
5. Minimise unutilized incidental catches of sharks
6. Contribute to the protection of biodiversity and ecosystem structure and function
7. Minimize waste and discards from shark catches following article 7.2.2. (g) of the Code of Conduct for Responsible Fisheries
8. Encourage full use of dead sharks
9. Facilitate improved species-specific catch and landings data and monitoring of shark catches
10. Facilitate the identification and reporting of species-specific biological and trade data.

The Panel consisted of a diverse range of experts representing national and international institutions, science and management knowledge, and fisheries, conservation and biodiversity expertise. The Panel members were:

1. Prof. Dr. Sven Kerwath, Specialist Scientist: Finfish (Linefish, Tuna and Sharks), Branch: Fisheries Management, DEFF (Chair)
   https://www.researchgate.net/profile/Sven_Kerwath
2. Dr. Charlene da Silva, Scientist: Shark Resources Research, Branch: Fisheries Management, DEFF (Convenor)
   https://www.researchgate.net/profile/Charlene_Da_Silva2
3. Mr Saasa Pheeha, Chief Director (Acting) Marine Resource Management, Branch: Fisheries Management, DEFF
4. Ms Sarika Singh, Scientist: Marine Biodiversity Research, Branch: Oceans and Coasts, DEFF
5. Ms Zintle Langa, Control Environmental Officer, Ocean Conservation Strategies, Branch: Oceans and Coasts, DEFF
6. Prof. Kerry Sink, Marine Programme Manager and Principal Scientist, SANBI
   https://www.researchgate.net/profile/Kerry_Sink

7. Dr. Alison Kock, Marine Biologist and shark scientist, SANPARKS https://www.researchgate.net/profile/Alison_Kock
8. Dr. Andres Domingo, Director: Large Pelagic Fisheries, National Department of Aquatic Resources, Uruguay. Co-chair of the Subcommittee for Ecosystems and By-Catch Mitigation at International Commission for the Conservation of Atlantic Tunas (ICCAT)https://www.researchgate.net/profile/Andres_Domingo2
9. Dr. Rishi Sharma, Fisheries Scientist, FAO. Mathematical statistician and stock assessment expert. Former head of stock assessment at Indian Ocean Tuna Commission (IOTC) https://www.researchgate.net/profile/Rishi_Sharma16

The outcome of this process will form the basis of an updated NPOA-Sharks by providing a roadmap for the implementation of priority actions related to the conservation and management of sharks and their long-term sustainable use in South Africa.

2. Workflow and methodology

The review process comprised three initial steps, with an additional two steps added during the review period.

1. The Panel undertook individual reviews of each research and management action in the NPOA-Sharks action table, made suggestions for further actions and commented on the NPOA-Sharks in its entirety. The Panel noted clarity, progress and challenges for each action.
2. The Panel re-evaluated the internal review process concluded by the Department in 2018 and scored the individual actions in terms of completeness.
3. The Panel discussed and prioritised all individual actions and comments. Suggestions were collated into a new action table draft as the basis for the revised NPOA-Sharks.
4. The Panel reviewed and responded to written input received from external stakeholders.
5. The Panel provided detailed recommendations and a roadmap to take this process forward.

The Panel briefly discussed whether the Shark Biodiversity Management Plan (No. 38607, gazetted in March 2015), which is separate from the NPOA-Sharks, should also be reviewed. However, based on the Terms of Reference and that the public concern was primarily around shark fisheries and their perceived direct and indirect impact, the Panel focussed on the NPOA-Sharks for this review. The first two steps of the review were completed simultaneously. The experts provided individual comments and recommendations on all 62 actions, in line with their expertise. Additional actions were recommended, and redundant or duplicated actions were identified. The Panel also commented individually on the overall format, alignment with the IPOA-Sharks, and content of the NPOA-Sharks, and made specific suggestions for improvement on the overall performance, structure and flow. Input and comments were reviewed, debated and discussed during regular virtual meetings with specific focus on the following elements:

- Alignment with the IPOA-Sharks (FAO)
- Overall structure of the document
- Completeness of the plan, highlighting any critical gaps
- Achievability of the plan considering timelines, funding and existing capacity
- Clarity of the actions and indicators
- Areas of general progress or lack of progress

Background documents, including permit conditions, Scientific Working Group documents and recommendations and published and unpublished information was provided to the Panel to evaluate and review the NPOA-Sharks. All individual and group input was captured in an Excel table that contained the original actions of the NPOA-Sharks. To quantify the progress made in each action cluster, and within each issue, actions were independently scored either 1 (significant progress), 0.5 (partial progress) or 0 (no progress). The individual Panel expert scores for each action were averaged and then aggregated for each of the issue clusters, namely, *data and reporting*, *classification and assessment of shark species*, *sustainable management*, *optimum use*, *capacity and infrastructure*, *capacity and infrastructure*, *compliance* and *regulatory tools.* Scores (expressed as a percentage completed) were compared to those made during the internal review process in 2018. Individual scores were discussed, and the Panel reached an agreement in 60 of 62 actions. Disagreement on the remaining two scores was related to the lack of clarity of the description and scoring criteria and resulting views on prioritization.

The Panel conducted 8 virtual meetings up to 3.5 hours long and reviewed 60 background documents. Additionally, the Panel reviewed and provided responses to six documents from four stakeholder groups. The review was also informed by three presentations by Panel experts on key issues around the reasons for the disappearance of white sharks from some aggregation areas, the decline of soupfin and smoothhound sharks in relation to the demersal shark longline and other fisheries, and the conflict between shark fishers and ecotourism operators.

3. Findings

The overall view of the Panel on the NPOA-Sharks was positive, acknowledging that the plan and implementation of some of the actions represents a substantial amount of work. The Panel agreed that the plan aligned with the IPOA-Sharks and covered all 10 aims therein in some way. The external experts commended the Department for the progress made in the implementation of the plan, especially with the limited resources, funding and human capacity available for implementation. The Panel acknowledged good progress has been achieved in foundational areas of the plan such as, taxonomic work and species assessments, and that South Africa's plans and achievements are of a high global standard that is more typical of developed countries such as the USA and Australia.

While the external experts were impressed by the completeness of the listing of issues and actions, there was consensus that the plan was overly ambitious considering the limited human and financial resources available for implementation, the plan needed more clarity on actions, prioritisation and measurable indicators. The external experts recommended that the plan needed prioritisation of actions and more measurable indicators in order to be achievable and to track progress more effectively.

In terms of the clustering of issues, the Panel recommended a more consistent level of detail per cluster. Furthermore, some actions were noted to be better suited under different clusters, and actions that overlapped with others should be consolidated or removed. The Panel identified areas of improvement and provided specific recommendations pertaining to the structure of the plan, clarity of issues and actions, prioritisation of actions to effectively manage all shark species occurring in South Africa's oceans, and to guide their long-term sustainable use.

Panel scoring

Table 1. Expert Panel combined scores on the NPOA-Sharks action table (2020). Green shading indicates good progress with a score of 67-100%, orange indicates moderate progress with a score of 34-66% and red indicates limited progress with a score of 0 – 33%. The complete table with individual scores and comments can be found in Appendix 2. *Capacity was increased during period, but recently lost.

Issue cluster	Panel score	Major achievements	Main challenge	Comments
Data and reporting Processes relating to the improvement of data from fisheries-dependent & independent sources	31%	• Identification guide of 100 chondrichthyes completed & provided to fishers from several targeted shark fisheries • Four shark specific management recommendations made through scientific working groups & permit conditions amended • Observer specifications drafted for all land-based & sea-based observer programmes which includes monitoring of discards & catch • Active participation in RFMOs & shark related issues • Conversion factors completed for soupfin, smoothhound and blue sharks • Catch composition and overlaps in catch between fisheries identified in da Silva et al. 2015 • Satellite tagging studies underway for shortfin mako and blue sharks	Lack of formal monitoring & observer programmes across all fisheries	Improved identification of sharks from fishers' logbooks & training of fishers, collection of fisheries independent data by observers, improved understanding of total catch & discards across fisheries Prioritisation of species & fisheries is required. The use of modern electronic systems would enhance & streamline actions Collaborate more widely with external institutions The lack of progress is mostly due to the absence of a formal observer program Missing detail e.g. the number of training sessions per quarter, in the description of the action also resulted in low scores
Classification & assessment of shark species	73%	• Species assessments completed for 21 species at a high global standard	No assessment of ecosystem effects of	Most notable achievements in this issue cluster includes stock assessments for demersal shark

Information needed for formal species assessments i.e. clarification of taxonomic uncertainty investigation into stock delineation, gaps in knowledge of life history, uncertainties related to unknown movement across RFMO & national boundaries, ecosystem changes induced by fishing		• Stock assessments completed for soupfin & smoothhound sharks • Six peer-reviewed papers on stock delineation and DNA barcoding • Updated life-history information for 100 chondrichthyans targeted or caught as by-catch • Two peer-reviewed papers on pelagic shark nursery areas and on a Red List assessment tool	fishing & little progress in habitat protection for sharks & the use of spatial management	species, inputs into stock assessments of global species and implementation of an IUCN Red List support tool applied to 21 species of chondrichthyans A priority species list is needed There needs to be improved integration and co-ordination of the NPOA-Sharks & the Shark Biodiversity Management Plan, especially to address ecosystem effects of fishing
Sustainable management Management protocols across all fisheries & coordination between fisheries &management	27%	• Scientific review on status and management of shark fisheries published in 2015	No management protocols exist for any fisheries	Little progress was made on these actions. The lack of co-ordination between separate management units within DEFF remains a barrier to effective implementation
Optimum use Research on the health risks associated with the consumption of shark meat, mitigation measures for unwanted by-catch, full utilization of shark catches and traceability of shark products from catch to sale	56%	• Three peer-reviewed publications examining trace metals in consumed sharks & subsequent de-commercialisation of vulnerable species e.g. broadnose sevengill sharks • New permit conditions requiring fins attached for the large pelagic fisheries • South African Seafood naming standard Gazetted (prevent seafood fraud) • Genetic identification method tested on confiscated shark fins • Several shark identification training sessions in collaboration with PEW, TRAFFIC & WWF	Little coordination among implementing agencies	Increased accessibility of information & wider stakeholder engagement on work done & in progress is required to maximise outputs & build relationships. Increased communication of scientific findings to managers, compliance & the public will help with implementing the findings Improved linkages between DEFF & customs officials is required
*Capacity & infrastructure**	39%	• Increase of scientific capacity (but recently lost again)	Little capacity & expertise to enforce shark related regulations	Increased collaboration with organisations already creating awareness around sharks is needed

Awareness, capacity to complete frequent assessments, funding & staff capacity		• Increased representation of DEFF researchers at international scientific working groups (IOTC, ICCAT & CCSBT)		Scientific capacity needs to be increased again as a priority action
Compliance Lacked sufficient detail on this objective.	50%	Improved compliance related to finning regulations & the aquarium trade	No transparency on compliance achievements & no regular training of compliance officers	The score might not be a true reflection of the compliance efforts as there was too little information for the Panel experts to gauge the accomplishments. The experts advised on more transparency in enforcement of compliance results e.g. in the form of an annual compliance report
Regulatory tools Lacked sufficient detail on this objective	20%	Continuous improvements in shark related permit conditions in Large Pelagic Longline Fishery • Shark has been designated as bycatch • Wire traces have been banned • Fins have to be attached during landing • Observer coverage of local fleet increased	No overarching framework for shark regulations. No regulation of shark catch in trawl and linefisheries No regulation of recreational fishing competitions & charter fishing	There is no overarching framework for shark management & no improvement on shark management in recreational fisheries

4. Stakeholder concerns and Panel responses

The Panel received six documents (SEP_2020_08_28#1, SEP_2020_08_28#2, SEP_2020_08_28#3, SEP_2020_08_28#4, SEP_2020_08_28#5, and SEP_2020_08_28 #6) from four stakeholder groups detailing several issues of concern. The Panel deliberated on the issues and responded to each one. Written responses were drafted in the form of letters to the respective stakeholders and are attached as Appendix (1). The Panel recommends that upon the Minister's approval, these response letters be sent to each stakeholder group. A short summary of the main issues and responses are provided below.

The disappearance of white sharks from some aggregation areas

The Panel noted with concern the disappearance of the white sharks from eco-tourism hotspots, but concluded that these were more likely a shift in distribution from west to east as a result of recent *Orca* occurrence and predation, rather than being related to the fishing activity of the demersal shark longline fishery. The Panel found no convincing connection between the disappearance of white sharks from False Bay and Gansbaai and the demersal shark longline fishery (Appendix 1.2 & 1.3).

The decline of demersal sharks and management concerns regarding of the demersal shark longline fishery

The Panel was concerned about the decline of soupfin and smooth hound sharks, but noted progress made towards halting this decline with scientific recommendations implemented to reduce catches and progress on assessment methodology. Permit conditions have already been changed in the demersal shark longline fishery to accommodate the reduction in catches. However, changes to permit conditions have yet to be implemented in the commercial linefishery and trawl fisheries (Appendix 1.1, 1.2, 1.3 & 1.4).

The perceived lack of habitat protection and spatial management for sharks

The Panel noted that the NPOA-Sharks lacked direct actions for habitat protection and spatial management for sharks but reflected on recent progress in Marine Protected Area (MPA) expansion. The Panel advised including specific actions to improve the understanding and management of the ecosystem effects of fishing and the identification of further priority areas for habitat protection and spatial management of sharks in the updated plan. It furthers recommended alignment with the Shark Biodiversity Management Plan. The Panel also provided recommendations to improve compliance and transparency around compliance issues if fishers transgress regulations or permit conditions (Appendix 1.1 & 1.2).

Conflict between fishers and tourism industries

Commercial shark fisheries and shark ecotourism are both important economic industries. However, these two sectors are for the most part incompatible. Therefore, user conflict mitigation measures are needed to identify and resolve potential user conflict in a timeous manner. The Panel recommended the urgent review of the TOPS and MLRA regulations, and the use of modern spatial management including MPAs to prevent and reduce conflict (Appendix 1.1, 1.2 & 1.3).

Fishing industry concerns

The Panel noted the concern from the fishing industry that socio-economic considerations might not be considered in the review (Appendix 1.5). The Panel noted that aim 2 of the IPOA explicitly mentions the implementation of "harvesting strategies consistent with the principles of biological sustainability and rational long-term economic use". The Panel noted that more effective dialogue is needed between the fishing industry and DEFF to communicate scientific findings, assessments and recommendations. It also noted the lack of species-specific reporting in the trawl fishery as a concern, and made recommendations for improvement. The catch has to be reduced by an order of magnitude across all fleets to achieve a turnaround in the trajectory of soupfin sharks, which is estimated to lead to commercial extinction by 2055 (Appendix 1.4).

The Panel was guided by the specific aims of the IPOA-Sharks. The aims of the IPOA-Sharks and the mission statement of the NPOA-Sharks make sustainability of target and bycatch species the primary considerations that inform decisions on rational long-term use. However, the Panel acknowledged the importance of socio-economic considerations in the management of sharks, and recommend an increase in the collection and use of socio-economic data to support decision-making (Appendix 1.5).

The above issues raised by stakeholders provided examples which highlight the need for improved communication within the Department, and between the Department and external stakeholders. The need for more effective and responsive science to policy mechanisms; the development and implementation of modern spatial management measures and enhanced compliance were also recognised.

5. Specific recommendations for immediate implementation

1. The experts identified that effective communication and coordination from science to policy is vital to achieve the actions of the NPOA-Sharks. This was especially applicable to compliance and implementation of management actions. It was applicable within different sections of the Department, and between the Department and external stakeholders (different branches of government, conservation agencies, NGOs, fishing industry, academics, and neighbouring countries). Timeous feedback amongst units within the Department, a significant shortening of the lag time between scientific advice and management action, and the transparent and rapid communication with stakeholders was considered to be extremely important.

2. The Panel emphasized the need for measurable indicators to track the progress and completion of actions. These should include timelines and quantities (e.g. the number of species assessments completed, percentage of observer coverage, etc.). The Panel recommended an adequate prioritisation of actions within the individual clusters to ensure that the species, gaps and pressures with the greatest need are prioritised. The Panel advised that actions should be clearly prioritized to maximise the available human and financial resources to implement the NPOA-Sharks.

3. The Panel noted that the ecosystem effects of fishing and spatial conservation and management measures need to be adequately covered in the plan. Emerging science demonstrates that area-based management can have positive impacts for shark and ray populations, and can reduce conflict between user groups. The IPOA-Sharks also specifically directs that critical habitats of sharks need to be conserved. Direct and indirect impacts of shark fishing on ecosystems, in particular interactions between consumptive and non-consumptive user groups need special consideration as there is considerable potential for conflict. The need for better coordination, communication and a framework for identifying and reducing conflict was emphasised by the Panel.

4. The Panel recommended a stronger focus on illegal, unregulated and unreported fishing and improved monitoring, surveillance and enforcement of compliance. The increased use of illegal gillnets along the coast are an emerging threat. Further, it was suggested that cancellation or suspension of fishing rights should be made public. Monitoring, reducing and optimising shark and ray bycatch in commercial fisheries, especially trawl fisheries, is a high priority. Increased effort is needed to better monitor and manage recreational fisheries, which are currently not monitored and inadequately regulated.

5. The Panel recommended modernising and integrating data collection and storage to improve access to data for improved assessments. The use of technology should be embraced to improve monitoring and evaluation of management actions and compliance with permit conditions. For example electronic monitoring programs such as camera-based scientific observer schemes, state of the art electronic vessel monitoring systems, utilization of drones for surveillance and compliance and online submission and storage of catch and effort data within modern cloud based data systems.

Additional improvements included sourcing socio-economic data, in addition to biological and ecological data, for holistic and informed decision making, and the development of adequate funding models to support the actions and implementation of the NPOA-Sharks.

6. Road map on the way forward

There were diverse ideas amongst the Panel on the most appropriate way forward. The experts agreed that there should be a public launch of the review and, when completed, the revised NPOA-Sharks in the form of an event, possibly with a presentation and question and answer session. This would demonstrate accountability and transparency and showcase the good work that the Department has achieved to date. The Panel also recommended that the revised NPOA-Sharks needs to be widely communicated and that buy-in is required from stakeholders, which includes various levels of stakeholder engagement from the public to policy makers. However, the Panel agreed that formally gazetting the new document may not be the fastest and most effective method of moving forward, especially since the original plan was gazetted for formal comment.

Proposed Road Map

A seven step roadmap was developed that, if implemented, can enable more effective science, management and compliance for shark fisheries in South Africa. The roadmap comprised the following proposed steps:

After endorsement by the Minister the findings of the Panel should be shared through an event and presentation on findings and actions by the Department, including a timeline for the actions, and a question and answer session. This could coincide with World Fisheries Day on November 21st

Initiate an internal process to assign responsibilities and time lines to the NPOA-Sharks new action table to maximise the Department's capacity and resources and identify gaps

Initiate an internal process to ensure harmonization between the Shark Biodiversity Management Plan and NPOA-Sharks to maximise use of the Department's capacity and resources and streamline mutually applicable actions or identify overlap

Develop a stakeholder engagement plan to:

Ensure that key relevant stakeholders are included in the updating of the plan e.g. use the Scientific Working Groups to select representatives from all stakeholder groups, in addition, lists of organizations and stakeholder groups that commented on the original NPOA-Sharks can be contacted

Circulate the draft new action table and plan to stakeholders for their input

Revise and update the NPOA-Sharks, including updating it with new catch and permit condition information

Develop a funding strategy and research plan as Annexures to the NPOA-Sharks

Formally launch the updated NPOA-Sharks with a dedicated event within a stipulated time-frame, ideally this should be completed within a year.

7. Conclusion

The Panel found that the South African NPOA-Sharks is in line with international standards and contributes to all ten goals of the IPOA-Sharks. The overall progress made is good and exceeds that of most other countries that have engaged in similar processes despite the ambitious plan and multiple constraints. The external experts' commended the hard work that South Africa has undertaken so far and the external review process of the NPOA-Sharks as a unique example of accountability and transparency.

The Panel scores of the individual issue clusters revealed good progress in the foundational areas of *taxonomy and assessment,* an area where the external experts felt that the work was on the same level as that of developed countries like the United States or Australia, moderate progress in *optimal utilisation, capacity and infrastructure development and compliance,* and limited progress in *data and reporting, sustainable management* and *development of regulatory tools*. The Panel agreed that better communication and coordination are needed to improve planning and implementation of actions and maximise use of existing human capacity and resources. The actions themselves should be further prioritised and their completion tracked through measurable indicators allowing for impartial review.

The Panel recommended an increased focus on the ecosystem effects of fishing and the use of spatial management to conserve critical habitats and reduce user conflict. Illegal, unreported and unregulated fisheries remain a problem that requires renewed focus, shark catches need improved monitoring, reduction and optimisation. Modernisation of reporting, monitoring and compliance systems will help South Africa to be more effective in accomplishing these shark management and conservation actions for the benefit of all South Africans. Other desirable improvements included sourcing socio-economic data, in addition to improved biological and ecological data, for informed and holistic decision making, and the development of adequate funding models to support the implementation of the NPOA-Sharks The Panel also drafted a new action table with further prioritised actions for the NPOA-Sharks, in line with the analysis and recommendations emerging from the review and this provides the core for an updated NPOA-Sharks.

The Panel recommended that the results of this report be widely shared with internal and external stakeholders for their input and provided a roadmap for the updated NPOA-Sharks to become an inclusive plan to implement the recommended actions for effective science, management and compliance for shark fisheries in South Africa.

APPENDIX 1: Panel Responses to Stakeholder input

1.1. Shark tourism operators and University of Miami

The Panel received a report produced by a group of shark tourism operators affiliated to the University Of Miami on the De Hoop Marine Protected Area document number: SEP_2020_08_28#1. The report was authored by Albano, P., Fallows, C., Fallows, M., Williams, L., Shuitema, O., Sedwick, O., and N. Hammerschlag (2020) titled: "Evaluating the Efficacy of a Marine Reserve (The De Hoop MPA) for Threatened and Endemic Sharks off South Africa". The stakeholders requested that the Panel consider the following 1) establishment of spatial protections for sharks beyond the Eastern Boundary of the De Hoop MPA across the Breede River mouth to include the Northern section of St. Sebastian's Bay, 2) increased monitoring of the entire MPA by qualified personnel.

The increased use of spatial management for the management and conservation of sharks and rays is recognized by the Panel as an important action for inclusion in the next iteration of the NPOA-Sharks. Several improvements have been suggested by the Panel including increased priority to ecosystem effects of fishing, habitat protection and spatial management. The previous iteration of the NPOA had no specific action linked to spatial conservation to mitigate against fishing impact. However, there has been significant progress in this area since the NPOA had been published. South Africa's Marine Protected Area (MPA) network was increased from 0.4% to 5.4% of the ocean area around mainland South Africa with the declaration of 20 new MPAs in 2019. Fisheries data, including data from shark fisheries, were used for the spatial planning decisions specifically for the new offshore MPAs. The Panel also recognised the need for strengthened compliance.

The Panel found it difficult to evaluate the report as the underlying data were not provided and there was limited detail in terms of data and methods. The report consisted of an abstract, a summary of the main findings and a list of recommendations.

From what was provided, the Panel found several inconsistencies: The authors argue that on the one hand, the current MPA seems effective in protecting the majority of focal species, indicated as higher encounter rates on BRUVs. On the other hand, the authors argued that the MPA is not sufficient and needs to be expanded. The authors have not provided information on sample numbers, nor sampling period. There is no mention of the effects of habitat on shark abundance (reef versus unconsolidated habitat), nor possible seasonal changes in abundance due to behavioural or environmental factors. From what was provided, it is not clear how the particular increase in area was derived. It would be useful to have information regarding the algorithm or mechanism that was used to determine those particular boundaries. There is little indication that the majority of the focal species are affected by fishing. Further spatial protection of a species needs to be considered in the context of the spatial distribution of the species and potential changes thereof. Spatial protection is effective in instances where ecologically and biologically sensitive areas and biodiversity hotspots are protected. In cases where a single species needs protection, mitigation against the primary threat (i.e. fishing with a particular gear) might be a more suitable alternative, especially when the area is utilised by multiple, competing stakeholders.

In summary, the Panel acknowledged that spatial protection including MPAs and Other Effective Conservation Measures (OECMs) can be used to support the conservation and management of sharks and needs to be better integrated into the revised NPOA. The specific application of these management options need to be carefully considered and weighed against possible unintended adverse effects, which can be socio-economic or ecological. Modern marine spatial planning, as used in the design of South Africa's offshore marine protected area network, taking multiple uses and pressures into account and an inclusive stakeholder engagement process ought to be used to inform future

spatial protection. To Panel concluded that in order evaluate the specific recommendations made in the received letter, the underlying data and analyses should be provided as this information could be included in future spatial planning. This includes emerging Marine Spatial Planning Measures, work to support the refinement of Ecologically or Biological Significant Marine Areas and potential management measures within these area and MPA expansion efforts. South Africa recently increased its MPA coverage and is soon to initiate consultation and planning for further MPA expansion.

1.2. Save Our Sharks group

The public group 'Save Our Sharks', a group consisting of members of the public and the Nelson Mandela Bay Tourism Association provided three documents, a petition outlining their concerns SEP_2020_08_28#2, background information SEP_2020_08_28#3 and a letter to the Panel SEP_2020_08_28#4. The group is also concerned that South Africa does not follow the FAO code of practice for responsible fisheries.

The **petition** specifies the following concerns:

1. Unsustainable shark fishing
2. Illegal fishing in MPAs and lack of enforcement
3. Sudden decrease in white shark numbers
4. Inadequate legislation to protect marine resources
5. User group conflicts: shark resources
6. Access to Information
7. Habitat Protection

The **letter** requested the immediate implementation of the following:

1. species-specific TAC (lower than identified in the stock assessments);
2. species-specific slot limits;
3. independent observers on board;
4. buffer areas for MPA's, protected species aggregation- and shark-nursery areas;
5. liaison and transparent communication with all stakeholder groups involved with shark natural resources;
6. ministerial approval to effectively implement the recommendations of the Panel and the allocation of adequate funding;
7. self-assessments and independent compliance audits on fisheries with respect to monitoring and enforcement of permit conditions; and the
8. evaluation of the DEFF mandatory compliance status with existing legislation and international agreements

The group provided summarized information largely based on DEFF literature, specifically the stock assessments of soupfin and smoothhound sharks. Using recent catch data they highlighted that the scientific recommendation on the level of catch of has been consistently exceeded since 2016. The group also draws on assessments from the South African Sustainable Seafood Initiative (SASSI) and several studies published and in preparation as well as anecdotal information.

The panels' deliberations on the petition:

The expert Panel noted that its primary role is to provide an appraisal of the South African National Plan of Action for sharks (NPOA-Sharks), highlighting its strengths and possible challenges. South Africa is a signatory to the International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks) developed in 1998, and the previous NPOA for Sharks (2013) was developed with the specific aims as outlined in the IPOA – Sharks. The development and implementation of which was consistent with our role as a signatory of the FAO Code of Practice for Responsible Fisheries as developed in 1995. The FAO Code of Practice for Responsible Fisheries (including article 6 and 7 as mentioned by the Save Our Sharks letter) was used to develop the IPOA-Sharks) in

1998.The Panel was in agreement that South Africa's NPOA is a substantial body of work and broadly covers all the aims as outlined by the IPOA-Sharks. Requests to immediately change management of fisheries in South Africa, amendment to spatial marine managements are not within the TOR of the panel. The Panel highlighted shortcomings in the current NPOA and its implementation and provided detailed input on how to improve an update of the NPOA were provided. The Panel had access to all relevant information, including the information contained in the save our sharks request and took this information into account.

1. Unsustainable shark fishing

The Panel noted that the stock assessments and risk assessments informing sustainable management are on par with international best practice. Several permit conditions were amended in response to the pessimistic outlook of the soupfin and smoothhound assessments. The permit conditions amended in May 2020 for the demersal shark longline fishery (DSL) now include:

1) The slot limit for soupfin, smoothhounds and requiem sharks of 70 to 130 cm TL

2) All sharks must be landed with heads and fins attached

3) All sharks below or above the slot limit have to be released with release condition recorded on logbook. Prohibited sharks must be released unless mortally wounded, in the latter case they must be declared in logbook, landed and handed over to Fisheries Control Officers during offload in an unprocessed state

4) Best practice for release

5) Rights Holders must carry one or more Observer on board per quarter at their own cost

6) Alternative to physical observers, rights holders are encouraged to use an electronic Monitoring system in consultation with the Department

In line with meeting catch limits for soupfin and smoothhound sharks as determined by the stock assessments, the introduction of the slot limit was recommended by the Scientific Working Group for the commercial linefishery. In addition, a precautionary Upper Catch Limit (PUCL) was recommended for soupfin sharks in the trawl fishery. *All* of these recommendations must be implemented for catch to decrease to desired levels. It must be noted that the demersal shark is one of three fisheries responsible for catching the majority of soupfin and smoothhound sharks in South Africa. This sector accounts for 13% of the total catch of soupfin shark and 70% of the total catch of smoothhound sharks in South Africa. The decline in soupfin shark stock precedes the development of the demersal shark long fishery by seven decades.

2. Illegal fishing in MPAs and lack of enforcement

During the review process, the Panel provided recommendations to improve compliance in the future. The Panel were made aware of criminal cases and Section 28 procedures within the DSL fishery relating to MPA transgressions. The Panel has requested information regarding existing criminal procedures for vessels in this fisheries.

3. Disappearance of white sharks from aggregation sites

The sudden decrease in white shark numbers has been noted as a major concern and the investigation of possible reasons, including the impact of fisheries was discussed in detail by the panel. The Panel found no conclusive information for a general decline of the white shark population in South Africa, but rather the evidence supports localized changes in abundance, probably due to a change in distribution from west to east. The Panel found some evidence for a causative link between the appearances of a pod of orcas that had specialised on preying on white sharks. The Panel found no causative link between the fishing activities of the DSL and abundance of white sharks. Further, the Panel noted that white sharks are generalist predators with a diet of over 40 prey species from four functional groups. The Panel further noted the lack of evidence that target species of the DSL represent a significant proportion of white shark diet. The Panel noted that further work is needed to understand ecosystem effects of fishing on shark populations and highlighted this as a recommendation for the improvement of the NPOA. Detailed deliberations are provided in document in Appendix 1.3.

4. Inadequate legislation to protect marine resource

The Panel was in agreement that South Africa's NPOA is a substantial body of work and broadly covers all the aims as outlined by the IPOA-Sharks, therefore adhering the FAO Code of Practice for Responsible Fisheries. The Panel acknowledged that legislation to protect marine resources in South Africa is fragmented and provided recommendations on how to improve management inefficiencies. Recommendations include shark specific permit conditions, fisheries management plans and harmonisation across sectors.

5. User group conflicts related to shark resources

Due to the diversification of commercial uses of sharks, and a growing shift from extractive/consumptive use to non-consumptive use, tension has been growing between user groups that have opposing business models. Commercial shark fisheries and shark ecotourism are two sectors which are incompatible. In general resource conflict has been dealt with by spatial separation through zoning, however when it becomes an issue of ecosystem integrity of areas where tourism is sited and/or the targeted removal of tourism significant species, traditional management tools need review. At present the dept. is reviewing the implementation of user-conflict mitigation measures that combine both species protection from fisheries (TOPS and MLRA review and revision) but also the spatial partitioning of user groups through MPA declaration, MPA Management Plan publication and revision and the designation of special coastal management areas.

6. Access to Information

Improved communication and coordination within the department and across different implementing agencies as well as feedback to its stakeholders (e.g. public, NGOs, fishers and other government departments) was one of the main recommendations by the Panel and several actions have been suggested for inclusion in the updated NPOA.

7. Habitat Protection

The Panel acknowledged that spatial protection is one of the tools in the management measures for sharks and needs to be better integrated into the revised NPOA. The specific application of this management option needs to be carefully considered and weighed against possible unintended negative effects, which can be socio-economic or ecological. Modern marine spatial planning, as used in the design of South Africa's offshore marine protected area network, taking the different pressures into account, ought to be used to inform future spatial protection. The Panel concluded that in order evaluate the specific recommendations, the underlying data and analyses should be included in future spatial planning (Marine Spatial Planning Measures and Protected Areas and MPA expansion efforts). South Africa recently increased its MPA coverage and will need to initiate stakeholder engagement and planning to guide further expansion efforts.

The Panel's deliberations on the requests contained in the letter

The TOR of the Panel does not include approval of requests, but the Panel did deliberate on each point and indicated when the requests were in line with recommendations of the panel.

1. Species-specific TAC (lower than identified in the stock assessments);

Total Allowable Catch based management is only practical in fisheries where all catch is weighed. Disaggregated small-scale fisheries such as the line fishery are managed in terms of effort and catch weight based management is not feasible. Further TAC can have unintended consequences such as discarding and high-grading. These need to be weighed up against perceived benefits.

2. Species-specific slot limits;

Slot limits have been in the implementation phase and where implemented in the DSL permit conditions in May 2020.

3. Independent observers on board;

On-Board observers are not always feasible on small vessels. Some observer coverage has been included in the DSL permit conditions and the pilot phase of electronic monitoring systems for this and other fisheries has started.

4. Buffer areas for MPA's, protected species aggregation- and shark-nursery areas;

Existing MPAs are already zoned for different activities. Aggregation and nursery areas are included in some of the MPAs, but Marine Spatial Planning requires detailed spatial data to be effective. Where available, these data are being considered and new efforts are underway.

5. Liaison and transparent communication with all stakeholder groups involved with shark natural resources;

The improvement of communication has been recommended by the Panel

6. Ministerial approval to effectively implement the recommendations of the Panel and the allocation of adequate funding;

The Panel only provides recommendation to the minister. The need for adequate funding and human capacity has been highlighted by the Panel.

7. Self-assessments and independent compliance audits on fisheries with respect to monitoring and enforcement of permit conditions;

The Panel made recommendations on the improvement of compliance and the communication thereof.

8. Evaluation of the DEFF mandatory compliance status with existing legislation and international agreements

The Panel found that the NPOA covers all the items outlined in the IPOA-Sharks in some way. The Panel also noted that South Africa does comply with conservation measures of regional fisheries management organisations, among others ICCAT, IOTC, CCSBT and FAO. The Panel further noted that South Africa has been a regional leader in shark conservation and management within these organisations and has attained 'green' status with respect to its compliance with bycatch regulations regarding sharks.

1.3. Deliberations by the Panel regarding allegations that the Demersal Shark Longline Fishery (DSL) is responsible for the white shark absence at eco-tourism hotspots in False Bay and Gansbaai

Save Our Sharks (Appendix 1.2) states that the disappearance of white sharks from False Bay and Gansbaai is because the demersal shark longline fishery has overfished demersal sharks. Consequently, Save Our Sharks requests DEFF to halt the demersal shark fishery to allow the white shark population to recover.

White sharks in Southern Africa occur throughout the Southwest Indian Ocean and are capable of extensive coastal and offshore migrations (Bonfil et al., 2005). In South Africa, there are several large aggregation sites, namely, False Bay, Gansbaai, Struisbaai, Mossel Bay, Plettenberg Bay, and Algoa Bay. Most of these aggregation sites have been the focus of research since the early 1990s, and are locations for white shark cage diving and viewing tourism. The absence of white sharks from two of these aggregation sites, False Bay and Gansbaai is cause for concern and deserves attention. This absence has received extensive media coverage since 2018. The cause for the disappearance has been the subject of much deliberation and debate within scientific and white shark industry circles. Since 2015 there has been a significant decline in the sightings of white sharks at Seal Island, False Bay (Hammerschlag et al., 2019). In Gansbaai, sightings of white sharks significantly declined from 2017 (Towner et al. in prep). In both cases, sightings declined steeply at first, followed by extended absences. Presently only a handful of sporadic white shark sightings have been confirmed for False Bay and Gansbaai. This is an unprecedented situation since research at these aggregation sites began in the early 1990s. However, the absence of white sharks has not been observed across their South African range with sightings still regularly reported at Mossel Bay, Plettenberg Bay and Algoa Bay.

The extended absence of white sharks in False Bay and Gansbaai has resulted in several observed changes in ecosystem structure, namely the emergence of sevengill cow sharks at Seal Island (False Bay) (Hammerschlag et al., 2019b), bronze whaler sharks in Gansbaai (Towner et al., in prep) and changes in seal behaviour (personal observation). There are likely other changes, but recording them is challenging in the marine environment. The absence of white sharks has also had a substantial economic and social impact on the economically important white shark cage diving industry (and associated leisure and travel industries) who rely on white sharks for tourist viewing. Therefore understanding the reason for the absence of white sharks is essential to determine if there are interventions or solutions to the problem.

White sharks can live for more than 70 years, and their movement patterns change between the different stages of their lives, e.g. juvenile sharks spend their time along the coast, while adults spend much time away from the coast. Movements are also different between males and females and even between individuals. Furthermore, white shark movements are influenced by the environment, e.g. water temperatures and food availability. They are generalist and are tolerant of a wide range of temperatures (although they seem to prefer 14 – 24 °C).

Prey availability is a key driver for movement and occurrence of predators, including white sharks. One of the primary drivers for white shark occurrence in False Bay and Gansbaai over winter months is the availability of naive Cape fur seals. A substantial body of evidence demonstrates the importance of seals in the white sharks' diet, especially for white sharks >3 m long (Fallows et al.; Hussey et al.; Kock et al., 2013; Martin et al., 2005). Seal populations are

stable in False Bay and Gansbaai (Pfaff et al., 2019), and the abundance of seals offer a predictable food source in time and space. The fact that white sharks have been absent even when naïve, young-of-the-year seals are abundant suggests that prey availability is not the primary reason for their complete absence around the seal colonies during winter months.

In summer months in False Bay and Gansbaai white sharks typically spend most of their time at nearshore sites in these bays where they have been observed feeding on seasonally abundant fish, sharks and rays. Studies on the South African white shark diet have identified they are generalist predators feeding on at least 40 different species from four main functional groups, namely cephalopods, elasmobranchs, teleosts and marine mammals (Hussey et al. 2012). White sharks are highly adaptive and likely predate on species that are most abundant and accessible in time and space. Prey availability of non-seal species may have changed along the South African coastline (due to environmental or anthropogenic reasons) which may influence white shark distribution and occurrence. However, there is no scientific evidence that indicates that demersal sharks such as soupfin and smoothhound sharks compose a significant portion of their diet. Therefore, claiming that white sharks are absent from False Bay and Gansbaai due to declines in some demersal sharks does not account for the fact that there are other prey species available to at least attract a few white sharks.

Some demersal shark species have undergone substantial declines with particular reference to smoothhound and soupfin shark populations. This decline deserves urgent management interventions in its own right.

White sharks have only disappeared from the Western Cape. In terms of catch composition the demersal shark longline fishery only catches soupfin in this region. The hotspot for smoothhound sharks is in the Eastern Cape where this fishery catches the majority of smoothhound sharks (70%). The demersal shark longline is one of three fisheries that catch soupfin (13%), the majority of soupfin is caught by the commercial linefishery (61%), followed by the trawl fishery (25%). Overall historical reconstructed catch data going back as far as the 1950s suggest that the decline in soupfin sharks predates the disappearance of the white sharks by 7 decades (DEFF, 2020).

Furthermore, white sharks have not disappeared from Mossel Bay, Plettenberg Bay and Algoa Bay, even though catches of demersal sharks (specifically smoothhounds) is by this fishery (has been) higher at these locations. Therefore, the decline of demersal sharks cannot explain the pattern of occurrence currently being observed for South Africa's white sharks.

An alternative theory proposed for the disappearance of white sharks from False Bay and Gansbaai is the recent appearance of a pair of killer whales specialising in hunting large, coastal sharks. This killer whale pair first appeared in False Bay in 2015, where they predated on several sevengill sharks which resulted in these sharks disappearing from a large aggregation site (Tamlyn Engelbrecht et al., 2019). In 2017 the same killer whale pair were suspected of predating on at least five large white sharks in Gansbaai. The number of white sharks killed by the killer whales may be higher and more frequent, as not all white shark carcasses would have washed ashore, and not all predation events recorded.

In addition to the direct effects of predation, the indirect effect of predation (or the fear of predation) has a profound influence on animal behaviour. Following these predation events, white sharks in Gansbaai disappeared abruptly. With each subsequent visit of this pair of killer whales, the white sharks fled the area and stayed away for extended periods (Towner et al. in prep). Since 2015, this killer whale pair has been recorded 41 times between False Bay and Gansbaai and to

date has predated on sevengill sharks, white sharks and bronze whaler sharks (David Hurwitz, unpublished data, Tamlyn Engelbrecht et al., 2019). The pair has not been recorded in Mossel Bay, and only once and twice in Plettenberg Bay and Algoa Bay, respectively. The significant impact of killer whales on white sharks is evident elsewhere. At the Southeast Farallon Islands in North America, brief and occasional visits by killer whales close to the island resulted in white sharks fleeing the immediate area and decreased predation by white sharks on pinnipeds during years killers whales were present (Jorgensen et al. 2019). Therefore the increased presence of these shark specialist killer whales may explain why white sharks have remained absent in False Bay and Gansbaai, but present in Mossel Bay, Plettenberg Bay and Algoa Bay.

To provide more conclusive answers on the reasons for the disappearance of the white sharks the following was suggested:

- Investigation of the ecosystem effects of fishing on predators is needed and should be included in the updated NPOA
- Continued investigation into the diet of white sharks, particularly in the Western Cape, and the drivers of movement
- Pooling of existing data from marine scientists to investigate ecosystem changes and possible impact on white shark occurrence
- Investigation of killer whale occurrence, movement and diet to confirm impact

References

Bonfil, R., Meÿer, M., Scholl, M. C., Johnson, R., O'Brien, S., Oosthuizen, H., et al. (2005). Transoceanic migration, spatial dynamics, and population linkages of white sharks. *Science (80-.).* 310, 100–103. doi:10.1126/science.1114898.

Fallows, C., Martin, R. A., and Hammerschlag, N. CHAPTER 9 Comparisons between White Shark-Pinniped Interactions at Seal Island (South Africa) with Other Sites in California. *Group*, 105–118.

DEFF. 2020. Recommendation for the sustainable management of demersal sharks for the 2020/2021 Season. Department of Envirionment, Forestry and Fisheries. pp 1- 15

Hammerschlag, N., Williams, L., Fallows, M., and Fallows, C. (2019a). Disappearance of white sharks leads to the novel emergence of an allopatric apex predator, the sevengill shark. *Sci. Rep.* 9, 1908. doi:10.1038/s41598-018-37576-6.

Hammerschlag, N., Williams, L., Fallows, M., and Fallows, C. (2019b). Disappearance of white sharks leads to the novel emergence of an allopatric apex predator, the sevengill shark. *Sci. Rep.* 9, 6–11. doi:10.1038/s41598-018-37576-6.

Hussey, N. E., Mccann, H. M., Cliff, G., Dudley, S. F. J., Wintner, S. P., and Fisk, A. T. (2012. "CHAPTER 3 Size-Based Analysis of Diet and Trophic Position of the White Shark (Carcharodon carcharias) in South African Waters," in *Global perspective on the biology of the white shark*, 27–50.

Kock, A., O'Riain, M. J., Mauff, K., Mëyer, M., Kotze, D., and Griffiths, C. (2013). Residency, habitat use and sexual segregation of white sharks, Carcharodon carcharias in False Bay, South Africa. *PLoS One* 8, e55048. doi:10.1371/journal.pone.0055048.

Martin, A., Hammerschlag, N., Collier, R. S., and Fallows, C. (2005). Predatory behaviour of white sharks (Carcharodon carcharias) at Seal Island , South Africa. *J. Mar. Biol. Ass. U.K.* 85, 1121–

1135.

Pfaff, M. C. M. C., Logston, R. C. R. C., Raemaekers, S. J. P. N. S. J. P. N., Hermes, J. C. J. C., Blamey, L. K. L. K., Cawthra, H. C. H. C., et al. (2019). A synthesis of three decades of socio-ecological change in False Bay , South Africa : setting the scene for multidisciplinary research and management. *Elementa*. doi:10.1525/elementa.367.

Tamlyn Engelbrecht, Engelbrecht, T. M., Kock, A. A., and O'Riain, M. J. (2019). Running scared: when predators become prey. *Ecosphere* 10. doi:10.1002/ecs2.2531.

1.4. Concerns raised by the South East Coast Fishing Association (S.E.C.I.F.A), an industrial body of the demersal trawl industry

The Panel noted the concerns of S.E.C.I.F.A document number: SEP_2020_08_28#5. These can be grouped into three sections:

1. Concerns about the quality of the shark catch data, due to the failure of species-specific reporting

2. Concerns about the validity of the assessment due to the shortcoming outlined in point 1 and possible omission of other auxiliary factors.

3. A proposal on how the fishery can assist in the required reduction in soupfin catch

The first two points fall into the Terms of Reference of the Expert Panel as they directly relate to action items outlined in the NPOA. The specific proposal in the third point does not fall within the TORs but the Panel deliberated on how it falls within the general recommendations in the NPOA.

1. Quality of catch data and failure of species specific reporting.

The NPOA specifically mentions accurate species-specific reporting as a necessity and prerequisite to effective assessment and management. While there has been progress in a number of fisheries, the Panel noted the lack of species-specific reporting in the trawl fishery as a concern. The quality of catch data needs significant improvement. Soupfin shark is reported as a separate species, apart from a category where shark species are lumped together. As shark species were not consistently reported individually, DEFF used the average proportion of soupfin shark in the catch of the demersal survey over the period 2005 to 2016 to estimate of the proportion of soupfin shark in the unspecified shark catch. While this estimate might be inaccurate it is unbiased and unlikely to produce a consistent over- or underestimate. The Panel is unable to evaluate the veracity of the crude analysis of S.E.C.I.F.A, as no method or data were presented, but applying the proportion (0.63) estimate to the figures that were supplied in the letter (0.5%-2% of 12000 t) would indicate a soupfin catch between 38 t and 151 t, which closely matches the range used in the stock assessment.

2. Validity of the model estimate

The assessment of the soupfin shark is based on a number of data sources. These include life history data, a fisheries independent abundance index and four catch data series. The model is, according to the experts, on par or even beyond what is currently international practice and represents best available science that can make valid inferences on this stock. The abundance index is derived from the annual trawl survey data and the standardization takes into account spatio-temporal changes in abundance. This index is also used in the risk analysis JARA, which complements the model and does not require other fishery-derived input data. This risk analysis, which is now used as a standard in IUCN assessments, indicates this species falls into the critically endangered ICUN category with a probability of 60.6%.

The model was run over four different scenarios with a number competing assumptions and several sensitivity analyses were carried out. All scenarios indicate a >99% probability that the soupfin shark is severely overfished and currently subject to overfishing. Given the life history of this species, the catch has to be reduced by an order of magnitude across all fleets to achieve a turnaround in the

trajectory of this species, which is estimated to lead to commercial extinction by 2055. This is a serious situation and requires immediate action across fisheries.

3. Proposed management actions

The Panel was sympathetic to the request and acknowledged the need for effective communication among stakeholders. The Panel also noted that training of sea going personnel and improved identification and recording of shark by-catch are in line with actions outlined in the current NPOA. However, it is unclear on how the action proposed by S.E.C.I.F.A will aid in halting the decline of the soupfin stock as the proposal does not seem to substantially reduce the catch, as required. It also noted the following: Some right holders already supply species-specific data, which indicates the feasibility of this action within this fishery. PUCLs and move-on rules are already implemented for a range of other by-catch species and represent current bycatch mitigation practice in this fishery.

The NPOA highlights the need for shark specific management interventions in permit conditions in particular in fisheries that impact shark populations. In the case of the soupfin shark, permit conditions in other fisheries that impact on this species (e.g. the midwater trawl fishery, the demersal shark fishery) have already been amended to mitigate against the decline. The implemented measures include an increase in observer coverage, slot limits, electronic monitoring as well as move on rules and precautionary upper catch limits.

1.5. Concerns raised by Hacky Fishing Pty LTD

The Panel noted the concern on the possible omission of socio-economic considerations during the review document number: SEP_2020_08_28#6.

The Panel is guided by the specific aims outlined in the International Plan of Action for the Conservation and Management of sharks (IPOA) developed by the FAO Committee on Fisheries in 1998, within the framework of the Code of Conduct for Responsible Fisheries to which South Africa is a signatory. Rational long-term economic use is one of these aims

(Aim 2): "*Assess threats to shark populations, determine and protect critical habitats and implement harvesting strategies consistent with the principles of biological sustainability and* ***rational long-term economic*** *use*."

Optimum sustainable use is also implicit in the mission statement of the NPOA-Sharks: *"The effective conservation and management of sharks that occur in the South African EEZ to ensure their* ***optimal, long-term, sustainable use*** *for the benefit of all South Africans, including both present and future generations*."

In practical terms, the aims of the IPOA and the mission statement of the NPOA make sustainability of target and bycatch species the primary considerations that inform decisions on rational long-term use. This translates into management practice that aims to reconcile the need for job and food security of current generations of stakeholders to those of future users. In terms of fisheries management, this means that management options that can simultaneously achieve conservation and socio-economic goals will receive preference. Examples thereof would be effective bycatch mitigation (e.g. species-specific management interventions such as size, bag, time and area limits)

The Panel acknowledged the importance of economic data to support decision-making in the management going forward and recommend increased collection and use of socio-economic data in the future. The outcome of the work of the Panel will not only result in the review of the NPOA-Sharks, but will form the basis for an updated NPOA-Sharks which will have some level of public consultation. I hope that you will find the above to address your request.

APPENDIX 2: New Action Table draft

ISSUE CLUSTER	ISSUE DESCRIPTION	ACTION NUMBER	ACTION	MEASURABLE INDICATORS	PRIORITY (as judged by the panel)
Foundations	Species prioritization - prioritise Chondrichthyes in need of research, assessment and management intervention	1	Input into and completion of species profiles report	Completion of report	Yes
		2	Species prioritization through gap analysis and Management Rapid Assessment Indicator procedure (MRAIT). Research plan developed.	Scientific Working Group documents: 1.Gap analysis (life-history vital for assessment and management) of Chondrichthyes caught in SA fisheries. 2. MRAIT assessment and selection of 5 priority species per period	Yes
	Biological sampling (conversion ratios, life-history, genetics) and research related to 5 priority species selected.	3	Biological sampling for prioritized species per fishery sector	Completed scientific reports at relevant scientific and management working groups	
		4	Conduct necessary research (basic life-history required for management) based on samples for priority species	Completed scientific reports at relevant Scientific and Management Working Groups	
	Monitoring catches (landings, observer coverage), web-based catch reporting (recreational)	5	Improve identification of Chondrichthyes caught in fisheries by distributing ID guides to rights holders in major fisheries, observers, compliance, inspectors and Customs	Frequent (TBD) ID courses for each group. Shark ID video instructions to supplement training. Improve	Yes

				communications between units	
		6	Develop and implement a scientific observer programme that includes land based and sea based monitoring with sampling strategy set for sharks. Set targets for monitoring of fin and trunk consignments.	Target strategy presented at relevant Scientific Working Groups (number of sites with effective landing monitoring programs and number of vessels with observers)	Yes
	Assessment of prioritised species	7	Regular assessments for soupfin and smoothhound sharks as per linefish protocol (Annual abundance indices and assessments every 2-3 years)	Presented at relevant Scientific Working Groups	Yes
		8	Investigate other data sources suitable for trend analyses through workshops/ calls for data	Distribute calls for data through SANCOR mailing list	Yes
		9	Risk assessments (JARA) for data deficient chondrichthyan species every 2 years	Presented at Scientific Working Groups of relevance	Yes
Sustainable mangement	Develop shark specific discharge, observer regulations across all fisheries	10	Re-establish, re -assess and expand land and sea based scientific observer coverage	Observer programmes established	Yes
		11	Establish web-based catch recording for recreational fisheries	Web-based recreational catch monitoring and control system implemented	Yes

		12	Establish additional monitoring requirements for fisheries for rare, vulnerable - critically endangered species	Monitoring implemented across relevant fisheries	Yes
	Shark specific regulations in all fisheries (permit conditions, etc.)	13	Review and develop regulatory tools (permit conditions, regulations and policy)	Permits in place, regulations and policies amended	Yes
		14	Develop and implement management protocols for all fisheries	Management protocols operational for all fisheries	Yes
		15	Harmonize shark specific permit conditions across all fisheries	Shark specific permit conditions harmonized	Yes
		16	Review existing mitigation measures, review mitigation measures used in other regions to develop best practice release protocols for all gear types	Presented at relevant working groups	Yes
		17	Develop best practice release protocols and incorporate into permit conditions where appropriate	Best practice release protocols incorporated in all relevant permits	Yes
Optimal use	Optimization of shark products from sustainable fisheries	18	Investigate better utilization of shark carcasses i.e. shark leather, alternative processing of shark meat in non-industrial fisheries etc.	Presented at relevant working groups	
	Develop protocols for ecotoxic species (Concern around health risk of shark meat consumption)	19	Develop research into prioritised commercial species for ecotoxicology and food safety	Presented at scientific working groups of relevance	

	Fisheries vs Tourism (MLRA vs TOPS?)	20	Develop protocols for removing sharks from permitted fisheries retention lists according to standardised criteria	Presented at scientific working groups of relevance	Yes
	Retained sharks are not fully utilized	21	Develop and apply finning legislation to existing fisheries, include skate wings	Finning legislation applied to existing fisheries and extended to include skates	Yes
Understanding and Management of threats	Ecosystem threats of related fishing (pollution, gear (ghost),	22	Review and identify fisheries and non-extractive impacts on sharks	Presented at relevant working groups	
		23	Investigate indirect, fisheries-related threats (i.e. post release mortality, plastic strops, etc.)	Advice for mitigation provided	
		24	Develop permit conditions to mitigate against these threats across fisheries	Permits in place, regulations and policies amended	
	IUU	25	Investigate Illegal, Unregulated and Unreported fishing activities	Regular, comprehensive, transparent updates on response to IUU activities provided	Yes
	Understanding the impact of fishing Chondrichthyes on ecosystems	26	Promote and encourage research that investigates the impacts of fishing Chondrichthyes on ecosystems. Link to BMP	Scientific report or published paper	Yes
	Spatial management and protection against fishery impacts (MPAs?)	27	Review existing protection for Chondrichthyes in MPAs.	List and quantification of Chondrichthyes occurring in each MPA	Yes
		28	Develop a spatial conservation plan for Chondrichtyes	Shark Biodiversity Management Plan updated, reviewed and implemented	Yes

		29	Promoting and encourage research that investigates the effectiveness of spatial protection	Scientific report or published paper	Yes
Co-ordination, stakeholder engagement and communication	Education and awareness	30	Determine requirements for educational material at various levels (school, tertiary, public etc.).	Educational material provided at relevant level	Yes
		31	Implement training on Shark identification (including fin, fillet, chain of custody)	Number of courses, number of staff trained	
		32	Develop responsible fisheries programs pertaining to sharks	Awareness programme rolled out to fishing community	
	Internal coordination within the Department	33	Coordination across Scientific Working Groups at DEFF: Fisheries Research and with DEFF: Oceans and Coasts	Scientists integrated across Branches. Regular research Indabas.	Yes
		34	Close coordination between science, management and enforcement	Increase in transparency of decisions. Scientific advice is acknowledged on reception. Deviations from advice is substantiated and documented in writing. Implementation of scientific advice is fed back to science and enforcement groups. Science to policy loop completed in one year.	Yes

		35	Coordination of assistance of enforcement activities	Number of affidavits and cross sectional groups established.	Yes
	Coordination among agencies	36	Formal use of the South African Seafood Naming standards in all permitting documents (exports, sale, transport, etc.)	Only official names and scientific names used for relevant documentation schemes (exports, imports, sale and transport)	Yes
		37	Relevant stakeholders are incorporated in scientific and management fisheries working groups	Stakeholders integrated into relevant working groups	Yes
	Communication	38	Develop mechanism to share new developments related to research, management and conservation of sharks	Rapid and frequent communication on new research, management and conservation efforts	Yes
		39	Roll out regular, transparent means of communication with stakeholders. Rapid response to incorrect and misleading media content. Timeous and comprehensive response to queries from stakeholders, including journalist, conservation agencies and fishers.	Number of responses produced within agreed time frame. Close communication lines	Yes
		40	Review of communication by means of modern technology (i.e. social media, electronic publication etc.)	Social media strategy developed and implemented	

	Explore funding opportunities	41	Explore funding opportunities through local and international agencies.	Additional funding sources established	