Update and review of the NPOA for Sharks South Africa

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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.

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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.

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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
								
								Large Pelagic Longline Fishery:
								• 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 Demersal Shark Longline Fishery: • 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

								Beach-seine and gillnet fisheries:
								• No retention of sharks and rays with the exception of beach-seine fishers in False Bay Demersal inshore trawl: • No by-catch restrictions but move-on rules apply to avoid high teleost and chondrichthyan catches Recreational linefishery: • 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

				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/Tr affic	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

Regulatory Tools	Inadequate regulatory reference to sharks	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 Management	Immediate	1	No progress due to attrition of staff within DAFF, scarcity of skilled resource managers and lack of assessments.