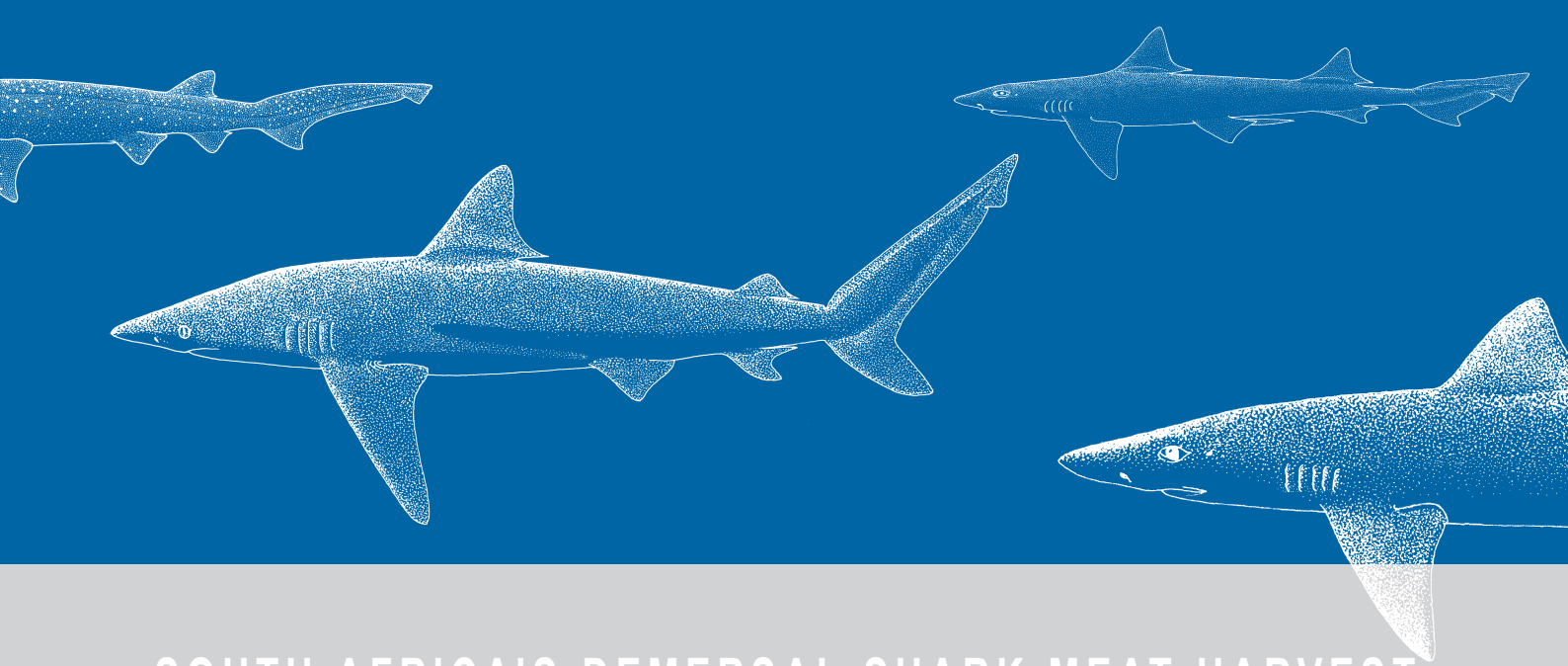

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SOUTH AFRICA'S DEMERSAL SHARK MEAT HARVEST

C. Da Silva and M. Bürgener

A number of demersal shark species are processed in South Africa for export to Australia, where there is high consumer demand for shark fillets that cannot be met by Australia's shark fishing industry. Most of these sharks are caught as by-catch but some are targeted in a number of South African fisheries. This paper examines the harvest of demersal sharks in South Africa, and the processing of demersal shark meat destined for export to Australia. Trade statistics for demersal shark products traded between the two countries during the period 1998 to 2005 were reviewed. The study shows that there is limited management and monitoring of the catch and trade in these species and related products; these inadequate regulatory controls, coupled with the increased targeting of demersal sharks in the South African traditional linefishery, could make certain species vulnerable to over-harvesting. Further, there are discrepancies in the import and export datasets for the two countries, and both the catch figures and trade data lack the necessary detail for effective monitoring and regulation of the catch and trade. Capacity building of compliance officers to improve identification of demersal shark products in trade is required and trade data discrepancies should be resolved. A review of trade categories used by Australia and South Africa for shark products in trade would assist in monitoring the trade.

Introduction

Historically, the shark fishery in South Africa has been inadequately managed. This lack of control also affects sharks caught as by-catch in a number of other South African fisheries. While there is a paucity of accurate biological and fisheries knowledge, recent preliminary stock assessments of two demersal shark species (i.e. sharks living or occurring in deep water or on the bottom of the sea) indicate that these species are overexploited.

Demersal sharks are primarily caught as by-catch in South African waters, with the bottom-trawl hake-directed fisheries posing potentially the greatest threat to sharks and other chondrichthyans.[1] Although catch data are available, there is doubt as to the validity of some of these figures, and there is inadequate monitoring of catches and landings. Furthermore, the pre-processing preparation of shark carcasses (headed and gutted) occurring on vessels at sea severely inhibits accurate species identification at the point of landing. Customs data in both South Africa and Australia, the major importing country, are inconsistent with known processed volumes. These aspects, coupled with anecdotal evidence of increased demand in shark fillets from Australia, make certain demersal shark species harvested in South Africa susceptible to overexploitation.

The first review of the trade in sharks and shark products in South Africa was conducted in 1996 (Smale, 1996). This was followed by an economic and sectoral study of the South African shark fishing industry (Sauer *et al.*, 2003). Unfortunately neither study paid particular attention to the trade in demersal shark products, and, in particular, the trade in demersal shark fillets to Australia. There is very little consumption of shark meat in South Africa, and Australia is the principal market for products derived from demersal shark landings in South Africa. Spiny Dogfish *Squalus acanthias* and Shortnose Spurdog *Squalus megalops*—two demersal shark species for which there is a market in Europe—are caught in South African trawl and Shallow-water Cape Hake *Merluccius capensis* longline fisheries, but are almost all discarded.

Although other products are derived from demersal sharks, the trade in the meat to Australia is perceived as the principal driver of harvest and trade within certain South African fisheries. This paper focuses on the trade in demersal shark meat, and specifically on trade in species destined for the Australian market.

[1] *Chondrichthyans or cartilaginous fishes are divided into two subclasses: Elasmobranchii (elasmobranches: sharks, rays and skates) and Holocephali (chimaera, sometimes called ghost sharks).*

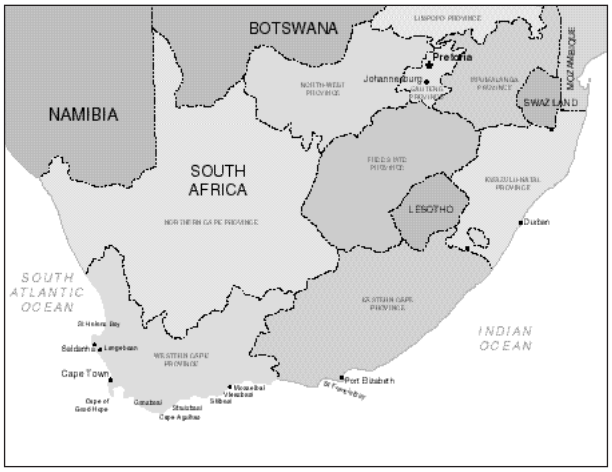

Figure 1. Principal fishery operations, landing and processing sites in South Africa for demersal sharks.

Background

Since the arrival of the early European settlers in South Africa in the mid-seventeenth century, there has been interest in shark fishing. The first documented account of gill net shark fishing is from the 1930s off the Kwa-Zulu Natal coastline (Sauer *et al*., 2003). Annual landings in 1931 were 136 t rising to over 1000 t by 1940 as the demand for shark liver oil as a source of vitamin A led to an increase in shark catches during World War II. In 1941, a directed shark fishery was initiated primarily targeting the Tope Shark *Galeorhinus galeus*.

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Smooth-hound *Mustelus mustelus*—the most commercially important demersal shark species in South Africa.

Despite the continued interest in shark fishing, this fishing sector had a low profile, competing in South Africa with an abundance of other marine resources, particularly the large commercial trawl operations that focused on the whitefish market for both local and export markets. Over the past decade, however, shark exports from South Africa have started to increase. A new directed shark fishery has since expanded into the fin trade and recently into the shark fillet industry for Australia (Da Silva, in prep.).

The demersal shark trade in southern Africa is primarily concentrated on five species. In order of commercial importance they are: Smooth-hound *Mustelus mustelus*, Tope Shark *Galeorhinus galeus*, Copper Shark *Carcharhinus brachyurus*, Dusky Shark *Carcharhinus obscurus* and Whitespotted Smooth-hound *Mustelus palumbes*. Copper Shark, Smooth-hound, Dusky Shark and Tope Shark are cosmopolitan species. Whitespotted Smooth-hound is endemic between Namibia and KwaZulu-Natal (Compagno *et al*., 1984). The Spotted Gully Shark *Triakis megalopterus*, Blacktip Shark *Carcharhinus limbatus*, Smooth Hammerhead Shark *Sphyrna zygaena* and Broadnose Sevengill Shark *Notorynchus cepedianus* are also used in the demersal shark trade to a limited degree. Table 1 lists the common and scientific names of all shark species mentioned in this report.

The 1991 collapse in the Australian Tope Shark industry (McGregor, 1991) led to increased importation from New Zealand to sustain high Australian consumer demand for shark fillets. According to Brand (pers. comm., 2005), the New Zealand shark fisheries were unable to sustain the Australian demand. As a result, demand for fillets of demersal sharks from South Africa has increased. This has led to larger catches of Tope Shark, both smooth-hound species, Copper Shark, Dusky Shark and to some degree Spotted Gully Sharks. As there is limited consumption of shark meat in South Africa, the vast majority of processed demersal shark meat is exported to Australia principally for consumption in the fish-and-chips trade.

Methods

In the period between April and July 2006, interviews were conducted with fishermen, traders and processors in areas of the Western Cape, Eastern Cape and KwaZulu-Natal provinces of South Africa. The purpose of the interviews was to obtain information on the trade in teleosts (fish with bony skeletons) and demersal sharks. Three South African demersal shark processing factories were visited between October 2005 and September 2006: the factory in Port Elizabeth was visited bi-monthly and the factories in Cape Town were visited quarterly over this period. All animals processed during a particular sampling day were identified, sexed, measured, and maturity assessed. Catch data for various South African fisheries were sourced from the South African Department of Environmental Affairs and Tourism: Branch Marine and Coastal Management

Common English name	Common name used in South Africa	Scientific name
Cape Elephantfish	St Joseph	*Callorhinchus capensis*
Copper Shark	Bronze Whaler	*Carcharhinus brachyurus*
Dusky Shark	Dusky Shark	*Carcharhinus obscurus*
Blacktip Shark	Blacktip Shark	*Carcharhinus limbatus*
Tope Shark	Soupfin Shark	*Galeorhinus galeus*
Shortfin Mako Shark	Shortfinned Mako Shark	*Isurus oxyrinchus*
Smooth-hound	Smooth-hound	*Mustelus mustelus*
Whitespotted Smooth-hound	Smooth-hound	*Mustelus palumbes*
Broadnose Sevengill Shark	Spotted Sevengill Shark	*Notorhynchus cepedianus*
Blue Shark	Blue Shark	*Prionace glauca*
Lesser Sandshark	Sandshark	*Rhinobatos annulatus*
Smooth Hammerhead Shark	Smooth Hammerhead Shark	*Sphyrna zygaena*
Spiny Dogfish	Spiny Dogfish	*Squalus acanthias*
Shortnose Spurdog	Shortnose Spiny Dogfish	*Squalus megalops*
Spotted Gully Shark	Spotted Gully Shark	*Triakis megalopterus*

Table 1. A list of all shark species referred to in this study, including their common names in English (used in this report) and South Africa.

(MCM) and from annual volumes of the Fishing Industry Handbook for South Africa, Namibia and Mozambique, and analysed. Catch records reflect only fish landed and do not include fish discarded at sea. International trade data between South Africa and Australia were obtained from annual volumes of the Fishing Industry Handbook for South Africa, Namibia and Mozambique, and from the Australian Bureau of Statistics, respectively, and analysed. Some of the information presented in this paper by Da Silva is developed in more detail in Da Silva (in prep.).

Little research has been conducted on investigating the status of demersal sharks exploited in southern Africa. Preliminary results suggest that the populations of Smooth-hounds and Tope Sharks are overexploited and threatened (Da Silva, in prep.; McCord, in prep.). To date, no stock assessment has been completed for Copper Shark, Dusky Shark or Whitespotted Smooth-hound. A rapid assessment indicator table (RAIT) was modified by McCord (in prep.) from Walker (2004). This method is a simple scoring system that rates biological, fisheries and stock assessment data, by assigning an arbitrary scoring system regarding data quality and certainty of biological and fisheries parameters, based on a scale of zero to three. A total score of 66 is possible. This method enables easy prioritization of species with regard to establishing the research and management required.

The RAIT method was initially used for an assessment of Tope Sharks (McCord, in prep.) and a score of 20 was obtained. The method was then used for Smooth-hounds, Whitespotted Smooth-hounds, Copper Sharks and Dusky Sharks, where respective scores of 16, 7, 27 and 27 were obtained. Scores of 0 to 30 indicate an immediate necessity for scientific and management intervention within the fishery (McCord, in prep.).

Regulation and Management

All fisheries in South Africa, as well as the processing, sale in and trade of almost all marine resources, are regulated under the *Marine Living Resources Act 18* of 1998 (MLRA). Under the terms of the regulations, sharks may not be landed, transported, transshipped or disposed of with their fins removed[2], without the authority of a permit. There are no commercial catch restrictions in place with regards to any demersal shark species caught in South African waters.

The Act also states that no person may operate a fish processing establishment unless authorized.[3] Fish processing establishments are defined in the MLRA as follows: " '*fish processing establishment*': means any vehicle, vessel, premises or place where any substance or article is produced from fish by any method including the work of cutting up, dismembering, separating parts of, cleaning, sorting, lining [i.e. the lining of packaging and/or the interleaving of plastic sheets between fish products] and preserving of fish, or where fish are canned, packed, dried, gutted, salted, iced, chilled, frozen or otherwise processed for sale in or outside the territory of the Republic' ".[3] A holder of a commercial fishing permit may not deliver any fish or any part thereof to any person for processing purposes without authorization.[4] The MLRA also prohibits a commercial rights holder from marketing any fish or any part thereof, unless it has been packed in accordance with the prescribed specifications of the South African Bureau of Standards.[5]

Landings are monitored in the Eastern, Western and Northern Cape provinces by MCM (Marine and Coastal Management) Fisheries Control Officers as well as monitors under contract to MCM. The latter have no enforcement powers. In KwaZulu-Natal Province, implementation of the MLRA is carried out by the provincial conservation authority, Ezemvelo KwaZulu-Natal Wildlife. The majority of officials in all provinces

[2]*Reg. 30(3)(b);* [3]*Section 1;* [4]*Regulation 74(d);* [5]*Regulation 74(g)*

Activity	Area	Nature
Offshore trawl	West Coast, Agulhas Bank to shelf edge (600 m depth)	By-catch only
Prawn trawl	Natal East Coast to 600 m	By-catch only
Inshore trawl	South and East Coast to 200 m	By-catch only
Hake longline	West and South Coast to 500 m	By-catch only
Shark longline	West and South Coast	Target
Domestic tuna longline	Offshore to EEZ	By-catch
Foreign tuna longline	Offshore to beyond EEZ	Target/by-catch
Recreational line	Inshore to 200 m	By-catch
Commercial handline	Inshore to 200 m	By-catch/target
Gill net	West Coast	Target
Beach seine	West and South Coast	Target/by-catch

Table 2. Activities impacting sharks in South African waters. *Source: Sauer* et al., *2003*

lack the species identification skills to identify correctly demersal sharks to the species level. Species identification is especially difficult for demersal sharks as they are normally landed having been headed and gutted at sea. Da Silva (2006) has developed a species identification tool for demersal sharks in trade that have been headed and finned.

Results

Harvest

Demersal sharks in South Africa are either targeted directly or caught as by-catch. Most are caught in the traditional linefishery, the inshore trawl fisheries, and the demersal shark longline fishery. While demersal sharks are at times targeted in the traditional linefishery, they are taken only as by-catch in the inshore trawl fishery. The main landing sites for demersal sharks are Port Elizabeth, Mosselbaai, Vleesbaai, Stilbaai, Struisbaai and Gansbaai, the principal species landed being the Smooth-hound and Tope Shark.

All known forms of exploitation of all shark species in South African waters are presented in Table 2.

A small shark longline fishery operates between Cape Agulhas in the Western Cape Province to Port Elizabeth in the Eastern Cape Province, with landing and processing sites based in Port Elizabeth and Mosselbaai; the primary species targeted are the Smooth-hound and Tope Shark. Longline permits for the directed catching of sharks were first issued in 1991 (Crawford *et al*., 1993). Prior to permitting, sharks were mainly caught as by-catch in other fisheries.

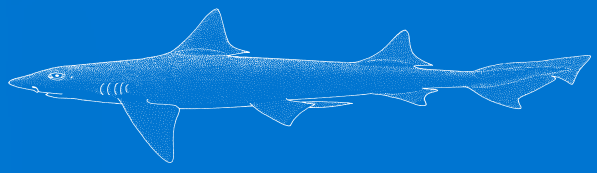
Vessels use two fishing methods to catch sharks. The first employs a drift longline and targets oceanic species such as Blue Shark *Prionace glauca* and Shortfin Mako Shark *Isurus oxyrinchus*. The second uses a bottom-set longline and targets Tope Sharks. Smooth-hounds are also caught. Crawford *et al*., (1993) suggests that the incentive to gain shark longline fishery permits was to exploit loopholes in the regulations to catch Shallow-water Cape Hake *Merluccius capensis* by longline, which had been banned in 1990. After large quantities exceeding the 1991 Total Allowable Catch (TAC) for hake (using other catch methods, e.g., trawling) had been caught by this method, boats in possession of shark longline permits were given hake and Kingklip *Genypterus capensis* catch limits. A number of the vessels in possession of shark longline permits have tuna permits and will, whenever possible, target fish associated with that fishery as they have a higher commercial value. The shark longline fishery was restructured in 2006 with the decision being made to regulate the catch of pelagic shark species (those living or occurring in the upper waters of open sea) within the existing large pelagic tuna and swordfish fisheries. Demersal shark catches are regulated separately and there are currently six rights-holders licensed to operate within this fishery. This is an effort-controlled fishery (i.e. regulation of fishing effort is used as a mechanism to limit catches. This is done

Year	Tope Shark *Galeorhinus galeus*	Smooth-hounds *Mustelus mustelus* *Mustelus palumbes*	Copper Shark *Carcharhinus brachyurus*	Shortnose Spurdog *Squalus megalops*	Total
2001	17 865	4 723	1 771	0	24 359
2002	8 230	1 503	1 870	42	11 645
2003	5 497	0	1 700	0	7 197
2004	9 922	5 210	3 007	0	18 139
2005	2 306	0	3 103	0	5 409
Total	43 820	11 436	11 451	42	66 749

Table 3. Catches (kg) of demersal sharks in the South African shark longline fishery, 2000 to 2005. These figures reflect the weight of the sharks after being headed and gutted.

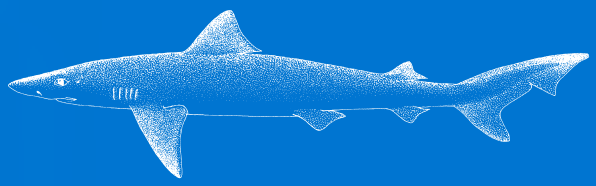
Source: Department of Environmental Affairs and Tourism: Branch Marine and Coastal Management

Smooth-hound *Mustelus mustelus*
Found in Mediterranean and West Africa to Namibia, and as far east as Durban, South Africa. Benthic species occurring from shore to 350 m, usually over sandy bottom. Feeds mainly on crabs, lobsters, prawns, mantis shrimp, cephalopods and bony fish. Females mature at 1.3–1.4 m (12–15 years); males at 95 cm to 1.3 m (6–9 years). Viviparous. Between 4 and 23 pups per litter.



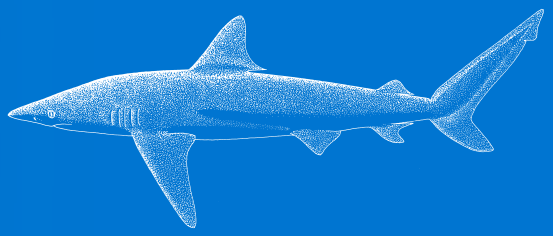
Smooth-hound *Mustelus mustelus*

Tope Shark *Galeorhinus galeus*
Found in temperate waters of the southern hemisphere, eastern North Atlantic and eastern North Pacific benthic species occurring from shore to 500 m. Feeds on a variety of fish, cephalopods and crustaceans. Females mature at 1.3 m (8–10 years); males at approximately 1.2 m. Ovoviparous. Between 6 and 52 pups per litter. Gestation period approximately 12 months. Females give birth during summer, producing only one litter every three years.



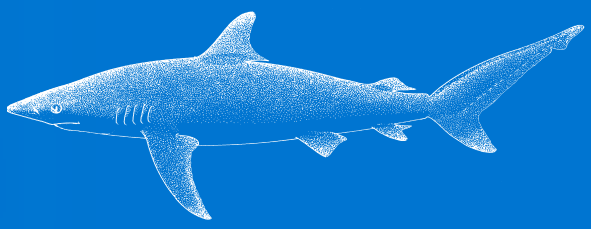
Tope Shark *Galeorhinus galeus*

Copper Shark *Carcharhinus brachyurus*
Found in warm temperate waters of all oceans. Common from Namibia to KwaZulu-Natal Province of South Africa. Coastal species usually near bottom from shore to 100 m. Feeds on benthic and pelagic fish as well as cephalopods. Females mature at 2.4 m; males and 2.0 m. Viviparous. Gestation period approximately 12 months. Between 13 and 20 pups per litter.



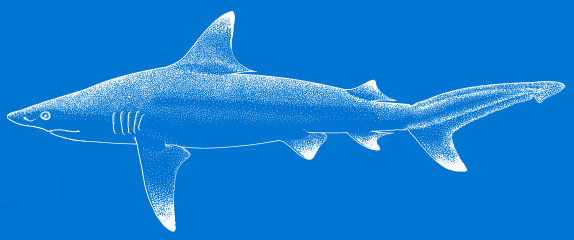
Copper Shark *Carcharhinus brachyurus*

Dusky Shark *Carcharhinus obscurus*
Found along continental coasts in warm temperate and tropical waters of all oceans; in Southern Africa: Western Cape Province of South Africa to Mozambique and Madagascar. Predator/scavenger feeding on a variety of fish (including sharks and rays), crustaceans, molluscs and dead marine mammals. Females mature at 2.6–3.0 m; males at approximately 2.8 m. Viviparous. Gestation period between 8 and 16 months. Between 6 and 14 pups per litter.



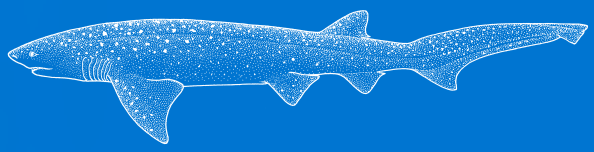
Dusky Shark *Carcharhinus obscurus*

Blacktip Shark *Carcharhinus limbatus*
Found in tropical and subtropical waters of all oceans. Found in both inshore and offshore waters, but tends to stay close to the coasts at depths of 30 m or less. Often seen near river mouths, bays, and mangroves, although it does not penetrate far into fresh water. Feeds on elasmobranchs, bony fish, crustaceans and cephalopods. Females mature at approximately 1.2–1.9 m (6–7 years); males at 1.35–1.80 m (4–5 years). Viviparous. Between 1 and 10 pups per litter.



Blacktip Shark *Carcharhinus limbatus*

Broadnose Sevengill Shark *Notorynchus cepedianus*
Found in temperate waters of all oceans. In southern Africa, from Namibia to East London, South Africa. Not found in the Mediterranean or North Atlantic. Benthic species found from shore to 136 m. Generally cruises slowly near bottom, but occasionally seen near the surface of the water. Feeds on elasmobranchs, bony fish, crustaceans, cephalopods, marine mammals and carrion. Females mature at approximately 2 m (11 years); males at 1.5–1.8 m (4–5 years). Ovoviparous. Between 60 and 82 pups per litter.



Broadnose Sevengill Shark *Notorynchus cepedianus*

Ovoviparous: Where embryos develop in membranous egg cases and are retained in the oviducts; the pups (between 10 and 300 per litter) subsist on their own yolk until birth. Viviparous: Where embryos develop in paired oviducts and receive additional nutrients from the mother; pups are born at a relatively large size and litters are small (between two and 20 pups per litter). Sources: Smith and Heemstra (1991); Heemstra and Heemstra (2004); Anon., (2007). Line drawings courtesy of FAO.

through limiting the number of vessels that can fish in the sector) and there are no Total Allowable Catch limits, bag limits or seasonal restrictions applicable to the fishery.

Total shark catches in the shark longline fishery for the period 2000 to 2005 amounted to 2.7 million tonnes, with the total figure for the demersal shark species being 66 t (Table 3). A decline in catches is evident with total catches of demersal sharks dropping from just under 24.5 t in 2000 to 5.4 t in 2005. Catches for all shark species in this fishery declined over the same period. The drop in catch is attributed to the decrease in effort rather than stock depletion.

Trawl fisheries

The inshore and offshore trawl fisheries off the coastline of the Eastern and Western Cape provinces target Deep-water Cape Hake *Merluccius paradoxus* and Shallow-water Cape Hake, Mud Sole *Austroglossus pectoralis* and Horse Mackerel *Trachurus trachurus*. Bottom-trawl hake-directed fisheries are potentially the greatest threat to chondrichthyans (Sauer *et al*., 2003). Sharks are caught as by-catch in these fisheries and include Tope Shark and both smooth-hound species, as well as other chondrichthyan species such as Biscuit Skate *Raja straeleni* and Cape Elephantfish. The most common shark caught in trawl fisheries on the Agulhas Bank is the Shortnose Spurdog. This species is generally considered to have a relatively high biomass but is too small for processing and has a high mercury[6] content (Da Silva, in prep.).

The actual number of chondrichthyans caught in the trawl fisheries is difficult to assess due to the high level of discard. Generally, the annual shark by-catch in waters off the coast of KwaZulu-Natal, for all fisheries including the Tugela banks prawn trawl fishery, is insignificant compared to the shark by-catch from the larger hake-directed trawl fisheries of the Eastern and Western Cape (Sauer *et al.*, 2003).

The trawl catch of sharks landed is a small proportion of the actual total caught in trawls which are then discarded (Sauer *et al.*, 2003). Although elasmobranchs[1] are of little importance to the demersal trawl industry, they contribute a considerable proportion of the sharks processed in factories (Da Silva, in prep.). Overall shark catches within the inshore trawl fisheries were estimated at 606 t in 1990. The Department of Environmental Affairs and Tourism (DEAT), in a draft 2005 policy on the inshore trawl fishery, noted its concerns over the volume of by-catch in the inshore trawl fishery but made no specific reference to sharks, limiting only the by-catch of Kingklip *Genypterus capensis* and Cape Monk *Lophius vomerinus* (Anon., 2005b).

Shark catches in the South African inshore trawl fishery are reflected in Table 4. Data captured for the years 1996 to 2002 reflect catch of all shark species under the term 'sharks', while Tope Sharks are separated from sharks in 2003, and, in 2004, separate figures are also provided for *Mustelus* spp. and Shortnose Spurdog.

The traditional linefishery

The commercial traditional linefishery is a boat-based activity and currently consists of 3450 crew operating from about 450 commercial vessels. The crew use hand line or rod-and-reel to target approximately 200 species of marine fish along the full 3000 km coastline, of which 50 species may be regarded as economically important.

Stock assessments conducted since the mid-1980s have revealed that with the exception of fast-growing species, most commercially exploited fish harvested in this fishery have been depleted to dangerously low levels. Responding to the poor status of most traditional linefish resources, an environmental emergency in the traditional linefishery was declared in South Africa in December 2000 (Anon., 2005c).

The decline in the South African linefish has led to increased exploitation of demersal shark species (Hutton *et al*., 2001; Griffiths, 1997) and there has been a steady increase in catches since 1991 (Sauer *et al*., 2003).

Year	Description	Nominal mass (t)[1]
1996	Sharks	106
1997	Sharks	166
1998	Sharks	214
1999	Sharks	117
2000	Sharks	143
2001	Sharks	132
2002	Sharks	219
Year	**Description**	**Nominal mass (t)[1]**
2003	Tope shark	243
2003	Sharks	280
2003	**Total nominal**	**523**
Year	**Description**	**Nominal mass (t)[1]**
2004	Shortnose Spurdog	9
2004	*Mustelus*	15
2004	Tope shark	180
2004	Sharks	133
2004	**Total nominal**	**337**

Table 4. Shark catches (t) in the South African inshore trawl fishery, 1996 to 2004.

Sources: Stuttaford, 1999; Anon., 2001, 2005; Department of Environmental Affairs and Tourism: Branch Marine and Coastal Management.
[1]Nominal mass figures are developed from the landed (dressed), weight figure, using a conversion factor of 2.59 except for 2000 where the factor is 2,452. The term 'nominal mass' refers to round weight.

[6]Mercury is a naturally occurring heavy metal. At ambient temperature and pressure, mercury is a silver-white liquid that readily vaporizes and may stay in the atmosphere for up to a year. When released into the air, mercury is transported and deposited globally. Mercury ultimately accumulates in lake bottom sediments, where it is transformed into its more toxic organic form, methyl mercury, which accumulates in fish tissue. Mercury is highly toxic, especially when metabolized into methyl mercury. Methyl mercury is avidly accumulated by fish and marine mammals and attains its highest concentrations in large predatory species at the top of the aquatic food-chain. By this means, it enters the human diet. Sources: World Health Organization Policy Paper: Mercury in Health Care August 2005: www.who.int/ifcs/documents/forums/forum5/mercurypolpaper. pdf. Air Quality Guidelines–Second Edition. Chapter 9 Mercury: WHO Regional Office for Europe, Copenhagen, Denmark, 2000: www.euro.who.int/document/aiq/6_9mercury.pdf.

Year	Reported catch (kg)
2000	328 828
2001	182 762
2002	174 348
2003	184 854
2004	301 054
2005	230 747

Table 5. Reported shark catches (kg) in the South African commercial traditional linefishery, 2000 to 2005. These data are treated as reflecting the weight of the sharks after being headed and gutted. There are no established conversion factors.

Source: Department of Environmental Affairs and Tourism: Branch Marine and Coastal Management

Species targeted include Tope Sharks, Smooth-hounds, Dusky Sharks, Copper Sharks, Spotted Gully Sharks, Smooth Hammerhead Sharks and the Broadnose Sevengill Shark (Da Silva, in prep.).

Traditional linefish crews generally target sharks when they are unable to catch sufficient linefish. A rights holder in the traditional linefishery noted that from October to December large quantities of Copper Sharks are caught in Mosselbaai as the south-east winds steer the sharks inshore. Sharks larger than 12 kg are discarded as they have little trade value owing to high mercury content and/or poor quality flesh (Arthur Riordan, pers. comm. to M. Bürgener, June 2006). This practice appears to support other anecdotal reports that shark meat, rather than the shark fin trade, is the key driver of the harvest of and trade in demersal sharks. It appears that the demersal shark catches would be insufficient to support a distinct handline fishery and that fishers in this sector require catches of both teleosts as well as sharks to make participation in the fishery a commercial viability.

It is not known how many sharks are caught in the recreational linefishery. While there is a significant body of anecdotal evidence of the illegal trade in teleosts caught in the recreational linefishery, the same is not true for chondrichthyans. There is no evidence of demersal sharks caught in the subsistence linefishery entering trade.

M. BÜRGENER

Tope Sharks caught in the traditional linefishery.

Shark catches (both demersal and pelagic species) in the South African commercial traditional linefishery for the period 2000 to 2005 are reflected in Table 5. Pelagic species comprise a small proportion of the shark catch for this fishery. Catch data were obtained from catch reports submitted by fishers to MCM and there is broad consensus that these data are inaccurate due to misreporting; the data are accorded some value for broad trend analysis, however.

Gill and beach-seine net fisheries

Gill and beach-seine net fisheries have operated traditionally on the South African west coast since 1652 and a directed gill net fishery for Cape Elephantfish was initiated in 1980. Other elasmobranchs caught in gill nets include Tope Sharks, both smooth-hound species and Lesser Sandsharks *Rhinobatos annulatus*. While beach-seine net fisheries target mostly bony fish species, significant quantities of elasmobranchs are frequently caught, comprising on average 70% skates and rays. These are usually not retained (Sauer *et al.*, 2003).

Recent studies of the in-shore net fisheries of the Western Cape have shown catch returns to be inaccurate, with up to 90% of the catch and effort, particularly of by-catch species, not reported (Hutchings and Lamberth, 2002). Estimates based on observed catch rates in monitored landings and the effort levels claimed by net fishers in a telephone survey show annual estimated catches of approximately 3500 over the period 1998 to 2000 (Hutchings and Lamberth, 2002). Hutchings and Lamberth (2002) note that gill net fishers in the Western Cape land approximately 130 t of by-catch annually, whereas illegal gill net fishers catch approximately 100 t of Smooth-hounds per year between 1978 and 2000.

Hutchings *et al.* (2002) note that other larger fish processors in St Helena Bay, Saldanha and Langebaan also deal in net-caught fish, producing dried or frozen Cape Elephantfish and Smooth-hound fillets for export.

Sourcing of demersal sharks for trade

Sharks processed primarily for the export of frozen fillets are sourced from the trawl, shark longline and traditional linefisheries. There are currently three companies in South Africa that process the vast majority of demersal sharks for export to Australia (another company, in St Helena Bay, was identified that processes and exports very small quantities—less than 12 t per annum—to Australia). Two of the companies are located in Cape Town and the third operates out of Port Elizabeth. The percentage of demersal sharks sourced from the various fisheries differs between the three factories. One of the two Cape Town-based companies noted that almost all of the demersal sharks purchased by this company are obtained from the traditional linefishery, as the crew on these vessels are generally aware of the storage and handling requirements that ensure good quality shark flesh.

Most fish buyers, traders and processors on the south-eastern Cape coast act as holding facilities for demersal sharks in trade and buy sharks from fishermen at a reduced cost to defray fishing costs not met by prime value teleosts. Such establishments process and trade in other commodities such as teleosts, abalone *Haliotis midae* and West Coast Rock Lobster *Jasus lalandii*. The sharks are purchased by these companies from the fishing vessels and are then sent to, or are collected by the companies that process and export the sharks.

Prices paid on landing (known colloquially as 'beach prices') for demersal sharks in Mosselbaai are higher (ZAR3.00–ZAR19.50 (USD0.45–USD2.8) per kg) than those received in St Francis Bay (ZAR3.00–ZAR8.00 (USD0.45–USD1.14) per kg) and Gansbaai (ZAR3–ZAR6.00 (USD0.45–USD0.85) per kg). The main reason for the difference in price is that the purchasing company in Mosselbaai is owned by one of the two Cape Town-based exporting companies and the sharks need not go through a third party (Da Silva, in prep.).

Grading

Sharks purchased from the various South African fisheries fall into three general trade categories with the following colloquial terms being used: 'good', 'bad' and 'big'.

'Good' sharks include the two smooth-hound species, Copper Sharks and Tope Sharks (the latter also referred to in the trade as gummy sharks) due to their high value flesh. 'Bad' sharks are those whose flesh has a lower value and include larger Spotted Gully Sharks, Smooth Hammerhead Sharks, and Blue Sharks. The term 'bad shark' is also used to reflect quality, in respect of which three different grades are given: 1, 2 and 3. Many factors influence the quality of the meat but are mainly concerned with on-board processing and storage of the animals. In order to obtain high quality shark flesh, sharks must be headed, gutted and bled immediately after capture. Following this they should be frozen or stored on ice; small sharks should be refrigerated whole (Da Silva, in prep.).

The term 'big sharks' in the demersal shark trade refers mainly to the mercury content of different species of sharks, rather than the physical size of the animals. Some shark species have a relatively low mercury content and would be of greater value than similar-sized sharks of other species with a high mercury content. Tope Sharks and Copper Sharks have trade value from 1.5 kg to 12 kg (Da Silva, in prep.), but specimens above 12 kg contain mercury that exceeds permissible limits. A higher price is paid for both smooth-hound species weighing below 12 kg, although animals above 12 kg are also bought but at lower prices. The pricing structure for smooth-hounds is not directly linked to mercury levels in different-sized animals but is affected, rather, by flesh quality. The flesh from large smooth-hounds shrinks when filleted and portioned, and flakes when defrosted. This lowers the quality of such specimens to grades 2 or 3. Anecdotal accounts note that the gall bladders of smooth-hounds caught over rocky areas may burst, spoiling the flesh. This problem has not been observed for Smooth-hounds caught over sandy areas (Da Silva, in prep.).

Storage and Processing

Processed small Spotted Gully Sharks, both the smooth-hound species, and Tope Sharks, are referred to as gummy or hound sharks. Copper Sharks, Dusky Sharks and Blacktip Sharks are processed and sold under the name Bronze Whalers. Blue Sharks and Short-fin Mako Sharks, both pelagic species, make up a small percentage of sharks processed (Da Silva, in prep.).

Care in handling the shark carcass subsequent to capture is of primary importance. Sharks should not be picked up by their tails as such handling tears the lateral musculature and lowers the quality of the flesh (Da Silva, in prep.). Both smooth-hound shark species are more susceptible to such damage as their flesh is described by processors as being almost as delicate as hake, and incorrect handling causes the flesh to become flaky.

Sharks generally arrive at processing facilities headed and gutted but with their fins still attached. One of the holding facilities trims the fins, which are subsequently dried and exported to Hong Kong. This practice does not appear to be commonplace, however, and is due to trade contacts in Asia associated with other seafood traded by this specific holding facility (Andries

Sharks generally arrive at processing facilities headed and gutted but with their fins still attached (1); the fins are removed (2), following which the sharks are filleted (3); the cartilage (4) removed during filleting is sold to a buyer and used in the traditional medicine sector; the fillets are packed in boxes (5) which are kept in cold storage before being exported to Australia for consumption in the fish-and-chips industry.

Year	Harmonized Commodity Description and Coding System (HS)	Mass (kg)	Value (USD)	USD (per kg)
2001	Dogfish, shark, other	37 133	44 868	1.2
2002	Dogfish, shark, other	79 741	460 872	5.78
2003	Dogfish, shark, other	97 307	932 948	9.59
2004	Dogfish, shark, other	79 552	405 449	5.1
2005	Dogfish, shark, other	50 217	145 015	2.89

Table 6. Exports of shark products from South Africa to Australia, 2001 to 2005.
Sources: Stuttaford, 1999; Anon., 2001, 2002, 2003, 2005a

Year	Harmonized Commodity Descriptions and Coding System (HS)	Mass (kg)	Value (AUD'000)	AUD (per kg)
2001	Dogfish and other sharks, fresh or chilled	23 265	207.25	7.02
1998	Dogfish and other sharks, frozen	514	1.33	2.05
1999	Dogfish and other sharks, frozen	21 282	75.66	2.84
2000	Dogfish and other sharks, frozen	92 875	408.18	3.47
2001	Dogfish and other sharks, frozen	124 523	698.21	4.42
2002	Dogfish and other sharks, frozen	9 203	32.20	2.76
2003	Dogfish and other sharks, frozen	0	0	0
2004	Dogfish and other sharks, frozen	0	0	0
2005	Dogfish and other sharks, frozen	0	0	0

Table 7. Australian imports of shark products from South Africa, 1998 to 2005.
Source: Australian Bureau of Statistics

Nouwers, pers. comm. to M. Bürgener, May 2006). Another holding facility noted that sharks not processed for the frozen fillet trade are used for fish meal (George Huishamen, pers. comm. to M. Bürgener, May 2006).

During processing, the fins are removed, following which the sharks are filleted, skinned and the fillets packed in boxes. Processors and exporters estimate the filleted weight to be approximately 50% of live weight. This estimate does not seem to be based on any specific method or calculation comparing live and filleted weight and should be treated cautiously, particularly as processors receive sharks that have already been headed and gutted and therefore do not have figures on the live weight of sharks. The boxes are kept in cold storage until there are sufficient to fill a container (approximately 10 to 12 t) and are then exported to Australia. Unlike the export of seafood products to the European Union, there is no requirement for the shark fillets to be checked by the South African Bureau of Standards.

The fins are sold to a South African buyer and are exported to Australia in frozen or dried form (Johnny Fouche pers. comm. to M. Bürgener, September 2006). An analysis of South African export data confirms the existence of such trade. The cartilage that is removed from the shark during filleting is sold to a buyer for use in the complementary medicine sector in South Africa and overseas.

All three companies processing and exporting demersal sharks are involved in the processing and trade in other seafood products. Inconsistency in supply and quality appear to preclude the commercial viability of an operation based exclusively on the processing and trade in demersal shark products. One of the trading companies noted that the demand for demersal shark fillets in Australia is high and is not being met by supply from South Africa and other countries. This company is accordingly exploring the possibility of exporting demersal shark fillets from Mauritania to Australia.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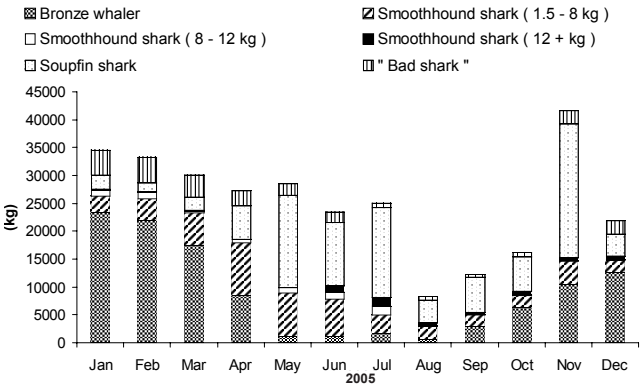

Figure 2. **Processed shark from single shark processing facility for 2005 for the categories: Bronze whalers (*Carcharhinus limbatus*, *C. obscurus* and *C. brachyurus*); Smooth-hounds (*Mustelus mustelus* and *M. palumbes*); Tope Shark *(Galeorhinus galeus)*; and, 'bad' sharks (*Sphyrna* spp., *Isurus oxyrinchus* and *Prionace glauca).***

A breakdown of sharks processed in 2005 by a Cape Town-based facility is summarized in Figure 2.

International trade

The export of shark products from South Africa to Australia for the period 2001 to 2005 and Australian imports of shark products from South Africa for the period 1998 to 2005 are shown in Tables 6 and 7, respectively. There is only one descriptive category for sharks within the South African Customs system: 'dogfish, shark, other'. It is not clear whether 'other' in this description refers to other chondrichthyans or only other elasmobranchs. Despite anecdotal evidence that exports of demersal shark fillets to Australia are increasing, South African trade data reflect a decrease in trade from 2003 to 2005.

While the figures for the shark processing facility in Figure 2 reflect an amount of approximately 300 t processed in 2005, the total export of 'dogfish, shark, other' (Table 6) is just more than 50 t for the same period. Given that there are two other facilities processing and exporting sharks, the discrepancies in the data are of concern. It is possible that other HS codes were used for exports of demersal shark and is a more likely reason than data entry error since export figures for other years are not substantially different. There is almost no domestic demand for demersal shark meat, which could otherwise have explained the discrepancies. Further research is required to determine the reasons for this disparity.


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REMOVING SHARK FINS AT A PROCESSING FACTORY IN CAPE TOWN

The value per kg of 'dogfish, shark, other' is inconsistent, ranging from USD1.2 per kg to USD9.59 per kg, with no clear trend.

A comparative analysis with Australian import data reveals significant anomalies. In 2001, South African exports to Australia were 37 133 kg whereas Australia shows imports of 23 265 kg of 'dogfish and other sharks, fresh or chilled' and 124 523 kg of 'dogfish and other sharks, frozen', totalling 147 788 kg. These discrepancies highlight a difference in volume between South African and Australian data of more than 100 t. In addition, South African data reflect exports of 'dogfish, shark, other' to Australia in the years 2001 to 2005 yet there is no reflection in Australian data of the importation of any shark products from South Africa during 2003 to 2005.

Discussion and Conclusions

While demersal shark species are caught in a wide variety of South African fisheries, there is little knowledge of their stock status, and there is no recent research on the impact of current harvest levels. The lack of knowledge of biology, population structures and movement patterns severely restricts the implementation of a successful shark management strategy.

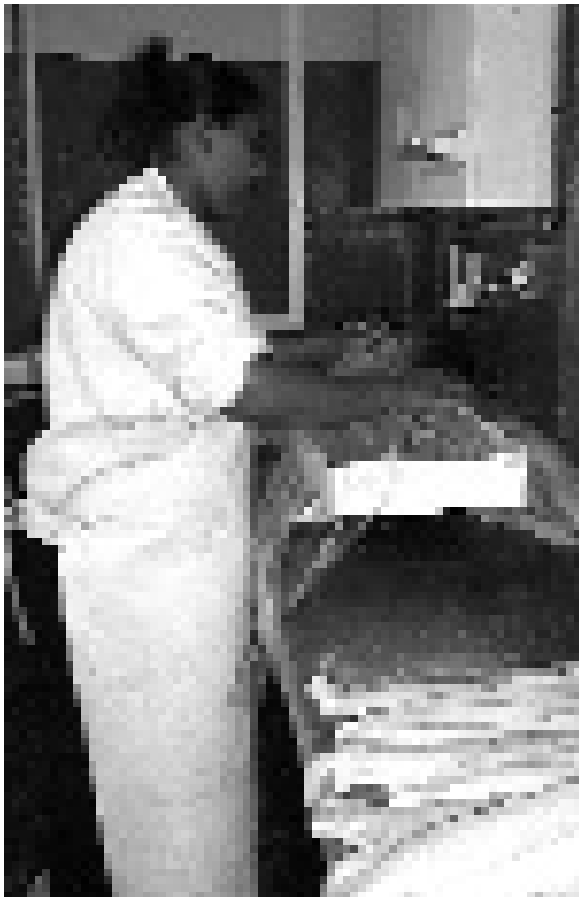
Whether caught as by-catch or as targeted species, few controls are in place to limit the harvest levels of all sharks, including demersal shark species. It is unclear whether the current levels of extraction are sustainable for all, or certain, demersal shark species. The only controls that currently exist are effort controls in the various fisheries in which sharks are caught. The slow growth, late maturity and low fecundity of most elasmobranchs make them vulnerable to over-exploitation and research should be conducted into the stock status of the targeted commercial demersal shark species as well as those of limited commercial value, yet exhibiting high catch levels.

Trawl catch data do not provide sufficient detail of shark species caught in this fishery; many shark species are reported under the generic description 'sharks', rather than to a species or family level which would assist in catch analysis and subsequent comparative analysis with stock levels. Encouragingly, catch reports for the 2003 and 2004 inshore trawl fishery demonstrate increased group allocations for sharks caught in this fishery.

Far more detailed data capture are evident in the commercial traditional linefishery where more than 10 species or descriptive names are used for allocating shark catches. However, the veracity of this

FILLETING SHARK TRUNKS (TOP) AND PACKING THE FILLETS IN BOXES (BELOW), PROCESSING COMPANY, CAPE TOWN. DEMAND FOR DEMERSAL SHARK FILLETS IN AUSTRALIA FOR THE TRADE IN FISH AND CHIPS IS HIGH BUT IS REPORTEDLY NOT BEING MET BY SUPPLY FROM SOUTH AFRICA AND OTHER COUNTRIES.

PHOTOGRAPHS: M. BÜRGENER



dataset is questionable allowing limited use for analytical purposes. Improved data capture at the point of landing by fisheries monitors and fisheries control officers is required to improve the quality of these data.

The decrease in catches of high value teleosts within the traditional linefishery will only increase the emphasis on fishing for sharks to defray costs. High beach prices and the spread of knowledge on the preparation of a shark carcass on board vessels are both likely to result in increased shark catches in future. There is therefore a need for demersal shark catch trends to be carefully monitored by MCM.

A comparative analysis of trade data for South Africa and Australia reflects significant discrepancies between the two datasets. As there are currently no catch limits related to any of the sharks used for the demersal shark fillet trade to Australia, there are no apparent reasons why exporters would choose to export consignments under a different Customs export category. It also remains unclear why Australian import data for the years 2003 to 2005 do not reflect the importation of shark meat from South Africa when it is clear from both South African export data, as well as significant anecdotal evidence, that such trade exists. Problems with these datasets preclude the use of the data as an indicator of minimum catch levels of demersal sharks. Given the poor quality and level of detail in much of the South African catch data, as it pertains to demersal sharks, accurate trade data could prove a useful proxy indicator of minimum catch.

Recommendations

- Research should be undertaken into the stock status of demersal sharks exploited in South African fisheries.
- Capacity building of fisheries control officers, monitors and other relevant compliance officials should be undertaken to improve their identification skills for demersal sharks.
- The processing and export of demersal sharks should be more closely monitored to improve knowledge in this sector, such that government is better able to identify associated trade trends and the extent to which trade is a driver for the targeting of certain demersal shark species.
- The demersal shark species identification toolkit developed by Da Silva should be distributed to all relevant compliance officials in South Africa. Where appropriate, the toolkit should also be distributed to compliance officials in other countries where the same demersal shark species are being exploited.
- Further research should be undertaken in both South Africa and Australia to resolve the data discrepancies between the import and export datasets for these two countries.