KENYA SHARKS BASELINE ASSESSMENT REPORT FOR THE NATIONAL PLAN OF ACTION FOR THE CONSERVATION AND MANAGEMENT OF SHARKS

Oddenyo, R. M., Mueni, E., Kiilu, B., Wambiji, N., Abunge, C., Kodia, M. A., Obota, C., Musembi, P., Muthiga, N., Bernard, J. and Mwasi, L. (2018) Kenyan shark baseline assessment report for the national plan of action for the conservation and management of sharks. Kenya Fisheries Service.

ABSTRACT

Sharks and rays form part of Kenya's fish landings for a long period with records dating back to the 1980s (Marshall, 1997). Out of a total of 45 species of sharks and rays that have a geographic range including Kenyan waters and have been assessed by the International Union for Conservation of Nature (IUCN), 19 are classified as threatened globally in the Red List (IUCN, 2018) amounting to ~ 40% while 9 species representing ~20% are categorised as near threatened. The remainder of species assessed and whose distribution spans Kenyan waters are either data deficient or of least concern in the IUCN Red list contributing to ~25% and ~15% of sharks and rays assessed in the country (IUCN, 2018). These findings are of much concern, and require focused interventions. The process of drafting the National Plan of Action for Sharks and Rays (NPOA-Sharks and Rays) was initiated by the State Department of Fisheries (SDF) in 2014 to comply with the guiding principles established in the International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks), in line with the FAO Technical Guidelines for Responsible Fisheries (FAO, 2000). In 2017, the Kenya Fisheries Service (KeFS, formerly the SDF) in collaboration with the Wildlife Conservation Society (WCS) set out to complete this process. Kenya has now developed a baseline assessment report, which is an important first step towards the development of a NPOA-Sharks and Rays for Kenya. This report has been compiled by team of experts and collaborating organizations with the objective of creating a first step towards developing Kenya's NPOA- Sharks and Rays.

Key words: *Incidental catch, IUCN Red List, NPOA-Sharks, baseline assessment report*

TABLE OF CONTENTS

1.0 INTRODUCTION
1.1 Background

Globally, shark populations in many coastal and open water ecosystems have substantially decreased over the past few decades raising concerns on their diversity, abundance and biological role as top predators. The International Union for the Conservation of Nature (IUCN) estimates that out of 1041 species of chondrichthyan (sharks, rays and chimaeras) assessed, nearly a quarter are at higher levels of vulnerability (Dulvy et al., 2014, Davidson et al. 2016)). A large proportion of these species are directly targeted by various fisheries or caught as bycatch. Furthermore, sharks exhibit characteristics such as slow growth rates and attaining sexual maturity at late life stages than a majority of fishes making them susceptible to overfishing which could lead to loss of biodiversity. Because of this concern, the United Nations Food and Agriculture Organisation adopted the International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks) developed by member countries in 1999. The IPOA-Sharks calls upon member states to create national plans, activities and and strategies that promote sustainable use, conservation and management of sharks and rays.

Sharks and rays form part of Kenya's fish landings for a long period with records dating back to the 1980s (Marshall, 1997). Sharks fall in the order within an ancient group of cartilaginous fishes in the class Chondrichthyes. Out of a total of 45 species of sharks and rays that have a geographic range including Kenyan waters and have been assessed by the International Union for Conservation of Nature (IUCN), 19 are classified as threatened globally in the Red List (IUCN, 2018) amounting to ~ 40% while 9 species representing ~20% are categorised as near threatened. The remainder of species assessed and whose distribution spans Kenyan waters are either data deficient or of least concern in the IUCN Redlist contributing to ~25% and ~15% of sharks and rays assessed in the country (IUCN, 2018).

Sharks and rays are captured by different fisheries sectors, namely the recreational, industrial and artisanal sectors. Recreational fishing, also termed as sport fishing or game fishing is whereby fishers catch fish for pleasure. This form of fishery is different from industrial fishing, which involves catching fish for sale on a large-scale basis, or artisanal fishing, which entails catching fish on a small-scale basis to provide animal protein and in some cases as a source of income. Sharks are harvested primarily for their meat, fins, skin, cartilage and liver (Musick, 2005). In Kenya, shark meat is either sold fresh, deep fried or salted and dried. Fins are primarily exported to Hong Kong, China and Spain according to trade data recorded by the Kenya fisheries service between the years 2006-2015.

1.2 Overview of Kenya's shark fishery

1.2.1 Off-shore fisheries

Kenya's offshore fishery comprises mainly of three locally flagged and foreign licensed fishing vessels from Distant Water Fishing Nations (DWFN), targeting the highly migratory tuna and tuna-like species which migrate through the Kenyan EEZ. The local fishing fleet currently comprise of two longliners, while the DWF fleets mainly comprise purse seiners and long liners operating under a fishing licensing scheme. There is also a fleet of 8-10 semi-industrial longline vessels operated by small scale fishers . Substantial amounts of shark catches have been recorded as by-catch in these industrial fisheries, especially from catch declarations and regional observer reports.

Kenya's former Fisheries Act CAP 378 required foreign fishing vessels to apply for a fishing licence under regulation 6 whereby the fishing plan of the vessel had to be provided. This plan was to outline the area of fishing, the exact number of fishing crafts, estimates for arrival and departure, proposed duration of fishing plan and outline of the calls into the Kenya ports during the duration of the plan. The new Fisheries Management and Development Act No. 35 of 2016, in addition to these requirements outlined in the old Fisheries Act requires foreign fishing vessels to land, trans-ship and declare catches in the country. Fisheries Act CAP 378 limited the country's benefits from its EEZ fisheries, especially from value addition activities associated with the value chains in trans-shipment, landing and processing or even from trade in by-catch. It was also a major gap in data collection and comparison of by-catch declarations that the new Fisheries Management and Development Act No. 35 of 2016 has been set in place to fill.

1.2.2 Inshore/ coastal fisheries

A major proportion of the coastal fishery in Kenya is artisanal (small scale mostly operated using canoes) with few motorised artisanal boats especially in the Northern Coast of Kenya. Some commercial exploitation of the prawn fishery is undertaken in the Malindi- Ungwana bay on the north coast. Similar to most countries in the Western Indian Ocean (WIO) region, substantial shark landings as well occur as by-catch have been reported in artisanal (especially gillnets and longlines) and prawn trawl fisheries.

Notably, rich inshore marine fishing grounds are located in and around Lamu Archipelago, Malindi-Ungwana bay, North Kenya Banks, and Malindi Bank. These are areas where the two major Kenyan rivers (Tana and Sabaki) empty into the sea and therefore making them productive. Prawn trawling in the rich inshore fishing grounds within the Malindi-Ungwana bay area has been carried out since the 1970s. The south coast inshore fishery also comprises of extensive biodiversity mix, including seagrasses, mangroves, sandy beaches, rocky-shore cliff species, coral reefs etc., and a wide reef platform running several kilometres seaward, thus enabling the thriving of abundant reef and reef-associated fisheries.

Relatively large quantities of sharks are landed from the artisanal fishery on the north coast of Kenya in comparison to that landed in the south coast especially in Kipini and Ziwayuu Island in Tana River County (Kiilu et al., 2019; Oddenyo, 2017) (Fig 3). For example, 306 tons of sharks were landed in the year 2011 from the artisanal fishery alone, with Tana River County contributing 34% of the sharks (Fisheries Department Annual Report, 2011). This artisanal shark fishery also supports 411 fishers (out of a total of 13,000 fishers coast wide) (Marine Frame Survey Report, 2014). Recent studies have also revealed that commercial prawn trawlers also catch significant amounts of shark bycatch (Kiilu et al., 2019). Despite there being a number of surveys that have been conducted on sharks, the abundance of sharks along the whole Kenyan coastline has not been determined.

1.2.3 Recreational Fisheries

Marine recreational fishing along the Kenya coast dates back to the days of Ernest Hemingways in the 1930's, and later became more prominent in the 1950s. There are no records of shark catches in these early years, but since mid-1980s, shark species have been recorded in Kenya recreational fisheries. The 1980s also mark a change in the Kenyan recreation fishing ethic whereby sport fishing anglers switched from a catch and kill to a catch, tag and release policy which allowed most of the gamefish species to be tagged using conventional hydroscopic plastic tags. The main gamefish species include marlin, sailfish, swordfish, tuna, kingfish, wahoo, and giant trevally among others. Evidence of about 18 species of sharks tagged by recreational anglers between 1987 and 2016 have been documented by the African Billfish Foundation (ABF) and the Kenya Association of Sea Anglers (KASA).

Game fishing methods and techniques vary according to the time of the day, area fished, the species targeted, angler preferences, and the resources available such as the size of the boat. Some of the methods practiced include trolling, bottom fishing and casting. The Kenyan marine recreational fishery consists of both sport fishing charter boats (sometimes referred to as charter sport fishing) and private sport fishing boats. The latter is characterized by the number of days fished which is usually a few times during a given fishing season and not for charter purposes.

Trolling with baited hooks and lures is conducted by charter and private boats in coastal waters and near seamounts. According to the ABF tagging reports, data submitted by sport fishing captains indicate that between 1987 and 2015, the quantity of coastal and pelagic sharks caught by troll gear varied yearly based on species of sharks. For instance, highs of 450kg for a tiger shark and 1000kg for the whaleshark. The total number of sharks tagged in recreational fisheries averaged ranged between 1 and 25 between 1986/87 – 2015/16 and peaked in 2003/04 and 2004/05 with 68 and 78 shark species tagged respectively. It is important to note that data reported for the purposes of this section only includes species of sharks tagged and release through the African Billfish Foundation tagging programme. Anecdotal evidence from recreational anglers has shown that a significant number of sharks are still landed or released without tagging.

1.3 Origin and Purpose of the NPOA-Sharks

In the year 1998, the UN-Food and Agriculture Organization (FAO) organized experts meeting to consult on an International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks). IPOA -Sharks aimed to address the growing concern for the rapid increase in shark catches and its impact on the populations of sharks and associated species. The overarching goal of the IPOA-Sharks is 'to ensure the conservation and management of sharks and their long-term sustainable use.'

To achieve this goal, the IPOA-Sharks suggests that member states of the FAO with fisheries that either target sharks, or regularly take sharks as incidental catch, should develop a National Plan of Action for the Conservation and Management of Sharks (NPOA-Sharks). Under this voluntary framework, participating States are encouraged to assess their current shark populations, identify threats to these populations, and provide special attention to vulnerable or threatened species. Member states are also encouraged to improve catch reporting, increase catch utilization, and enhance frameworks for broad stakeholder consultation. As a member State of the UN, Kenya has an obligation to develop a NPOA-Sharks.

The IPOA-Sharks identifies management principles at a strategic level and proposes a suite of generic operational objectives for NPOA-Sharks. Approximately, 24 species of sharks have been recorded, from artisanal field survey assessments (KeFS). In addition,, Kenya has developed a comprehensive fisheries management system for managing extractive fisheries and for protecting threatened and endangered marine species from the effects of fishing through the enactment of the Fisheries Management and Development Act No. 35 of 2016. This law is applicable to shark species as it does to other forms of aquatic life in the Kenyan fisheries. However, in the development of the NPOA-Sharks, prescription of measures and actions need to focus on a management system specific to sharks and rays species.

Within the FAO's IPOA-Sharks, the term "sharks" includes all species of sharks and related species of skates and chimaeras (class Chondrichthyes). In line with the overall definition of "sharks", it is important to note that the IPOA principles and provisions apply to all of the species.

In 2014, The State Department for Fisheries and the Blue Economy (SDF&BE) initiated the process of drafting the National Plan of Action for Sharks and Rays (NPOA-Sharks and rays). A roadmap to complete the document was developed comprising of three steps, namely; 1) Development of draft shark assessment baseline report 2) Ecological Risk Assessment and 3) Drafting of the NPOA- sharks plan. In 2017, the Kenya Fisheries Service (KeFS) in collaboration with Wildlife Conservation Society (WCS) and contributing partners started the process by preparing the baseline report. This document signifies the first step towards developing a national plan of action for sharks and rays.

1.4 Objectives of the NPOA sharks

The de facto objectives of the National Plan of Action for Sharks would follow those outlined in the Fisheries Management and Development Act, 2016 (No. 35 of 2016) which is 'to protect, manage, use and develop the aquatic resources in a manner which is consistent with ecologically sustainable development, to uplift the living standards of the fishing communities and to introduce fishing to traditionally non-fishing communities and to enhance food security' and 'to meet commitments that have been made internationally.'

The implementation of these objectives shall be guided by the following principles adopted from the Fisheries Management and Development Act, 2016 (No. 35 of 2016) to suit the shark and ray fisheries:

i. Application of the ecosystem based approach to fisheries management in the shark fishery.
ii. Encouraging equity between parties that utilize shark resources.
iii. Application of the precautionary approach to the management.
iv. The development of the shark fishery at no less standard than is set out in any international agreement.

1.5 Data sources

Information used in this document was obtained through a desktop study of published sources and technical reports and field surveys with a primary focus on data from fish landings. Different datasets and information sources that were relevant to this work included the following:

a) Catch Assessment Surveys (CAS) and Annual Statistical Bulletins (Kenya Fisheries Service)
b) Status of the Fisheries reports (Kenya Marine and Fisheries Research Institute (KMFRI).
c) By-catch Assessment and Mitigation in Western Indian Ocean Fisheries project (BYCAM)-WIOMSA MASMA grant
d) Indian Ocean Tuna Commission (IOTC) and the Food and Agricultural Organisation of the United Nations (FAO) reports.
e) Baited remote underwater visual surveys (A Rocha Kenya).
f) Journal article (Kiilu et al., 2019)
g) M.Sc. theses on the distribution and ecology of sharks (Kiilu et al., 2016 and Oddenyo, 2017).
h) African Billfish Foundation (ABF) - Database
i) Kenya Association Sea Anglers (KASA)

1.6 The Shark Fishery in Kenya

Sharks have been exploited in the Kenyan territorial waters since the late 1980's by off-shore industrial foreign fishing vessels, artisanal fishing vessels and recreational boats that operate within Kenya's EEZ (Fig. 1)

Kenya has jurisdiction over her 12nm territorial waters and licences artisanal fishers as well industrial and recreational vessels to carry out fishing within this exclusive economic zone (EEZ) (Fig. 1).

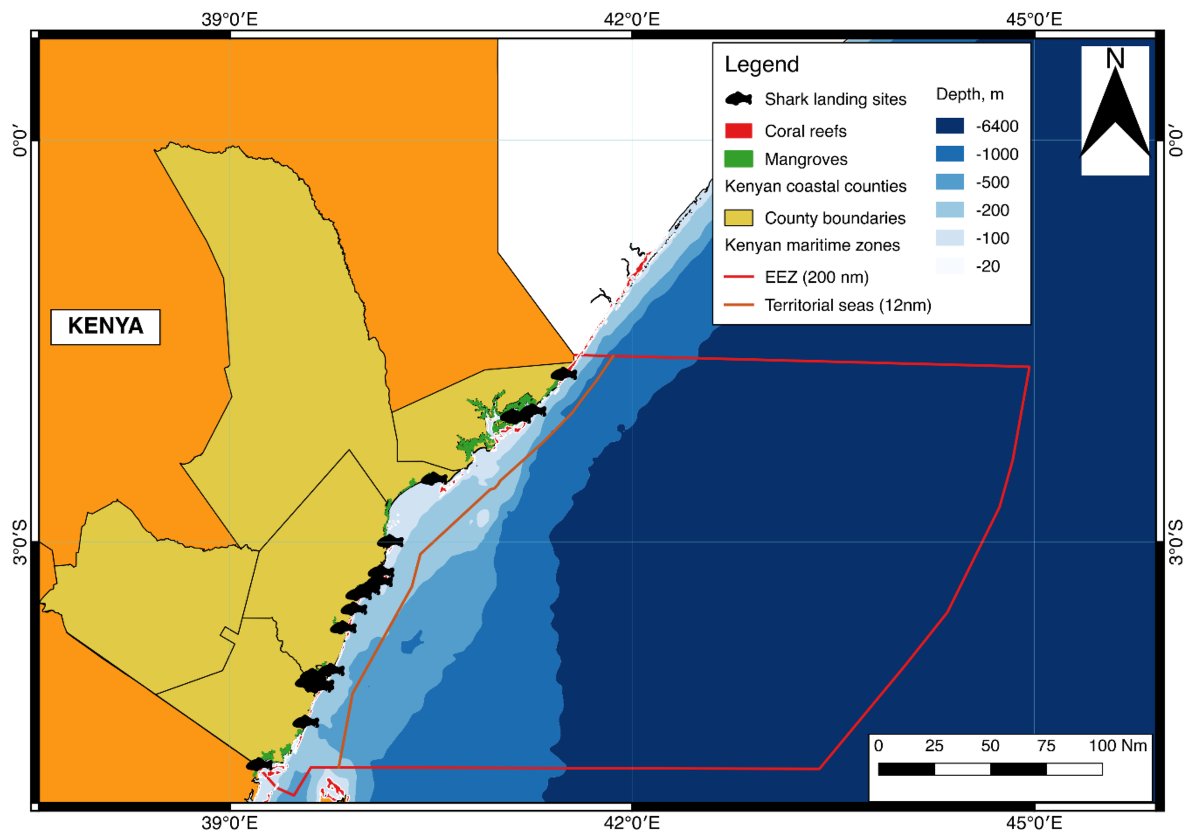


Figure 1. Landing sites that have recorded catches of sharks and rays.

2.0 SHARK CATCHES IN KENYAN FISHERIES

2.1 Catch trends in artisanal and semi-industrial fisheries

The shark fishery in Kenya entails both targeted as well as incidental catches. The small-scale fishery targeting sharks is made up of artisanal fishers utilizing canoes, outriggers or wooden boats powered either by oars, long sticks, sail or engines (Fulanda, 2011; Samoilys et al. 2011; Munga, 2014). Shark catches have been recorded in semi-industrial offshore fisheries that use handlines in the North Kenya Banks. Nearshore fishers in sites such as the Malindi-Ungwana bay utilize various types of gear such as seine nets, monofilament nets and handlines to capture sharks.

In Mombasa County, semi-commercial vessels using long lines are reported to target sharks which mostly consist of thresher sharks, *Alopii sp.* and mako sharks, *Isurus sp.* (Kiilu and Ndegwa, 2013). Sharks have also been reported as by-catch in industrial prawn fishery that operate in the Ungwana bay. Records at the Kenya Fisheries Service indicate that there was a steady decrease in shark catch between the year 1984 to 2000 from a total weight of 275 MT to 115 MT (Fig. 2). However, this trend changes from the year 2000 to 2015 with an increase in catches and peak weight of 373 MT in 2012 which could possibly imply to higher exploitation rates of these species (Fig. 2).

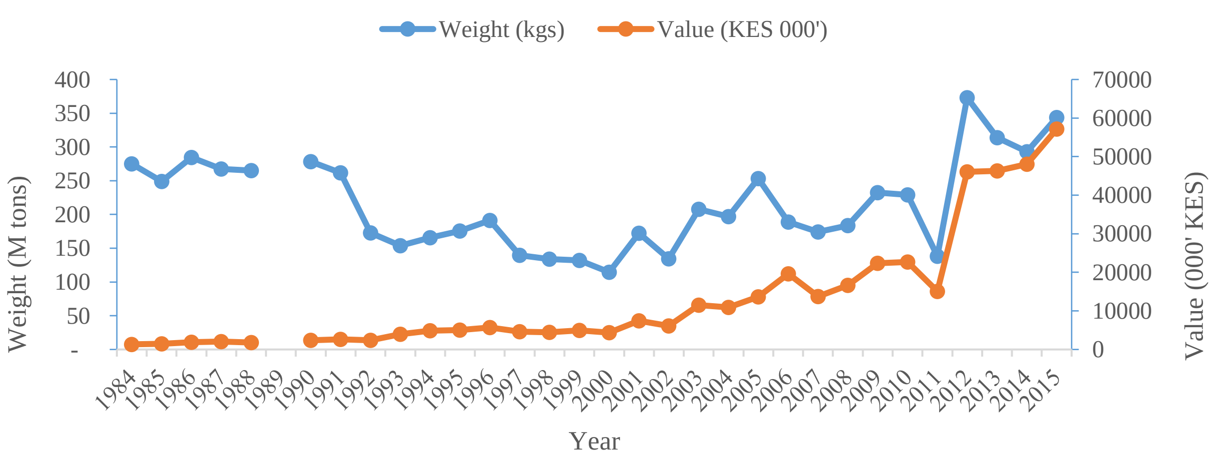


Figure 2. Catch in metric tons and value in Kenya shillings of sharks in Kenya between 1984 and 2015. Source: KeFS Annual Statistical Bulletin.

2.2 Shark catch species composition and its distribution in the artisanal and industrial fisheries.

Sharks and rays are landed on the entire Kenyan coastline from Kiunga in the north coast of Kenya close to the Somalia border to Vanga, a site located at the Kenya-Tanzania border (Fig. 3).

Sites in the Kenyan coast that contribute the largest proportion of catch in metric tonnes include Kizingitini, Kipini, Mbuyuni, Watamu and Mombasa Old Port.

Published data for the period 1989-1994 and 2007-2015 indicates that a number of shark species have been landed on the Kenyan coast (Table 2). However, these data consist of aggregated landings from different data sources.

The species composition of shark catches recorded from 1989 to 2016 is poorly known except for key species that are distinguished under national statutory requirements, largely for IOTC, SWIOFC, FAO. These comprise Mako sharks, *Isurus* spp. at 37% by number of the catch and Blue sharks, *Prionace glauca* at 34% (Table 2). The remaining sharks identified to species level comprise of 29% by number of the catch between these periods with a large proportion from the family Carcharhinidae (Kiilu and Ndegwa, 2013, Kiilu et al., 2019, Kiilu, 2016, Oddenyo, 2017).

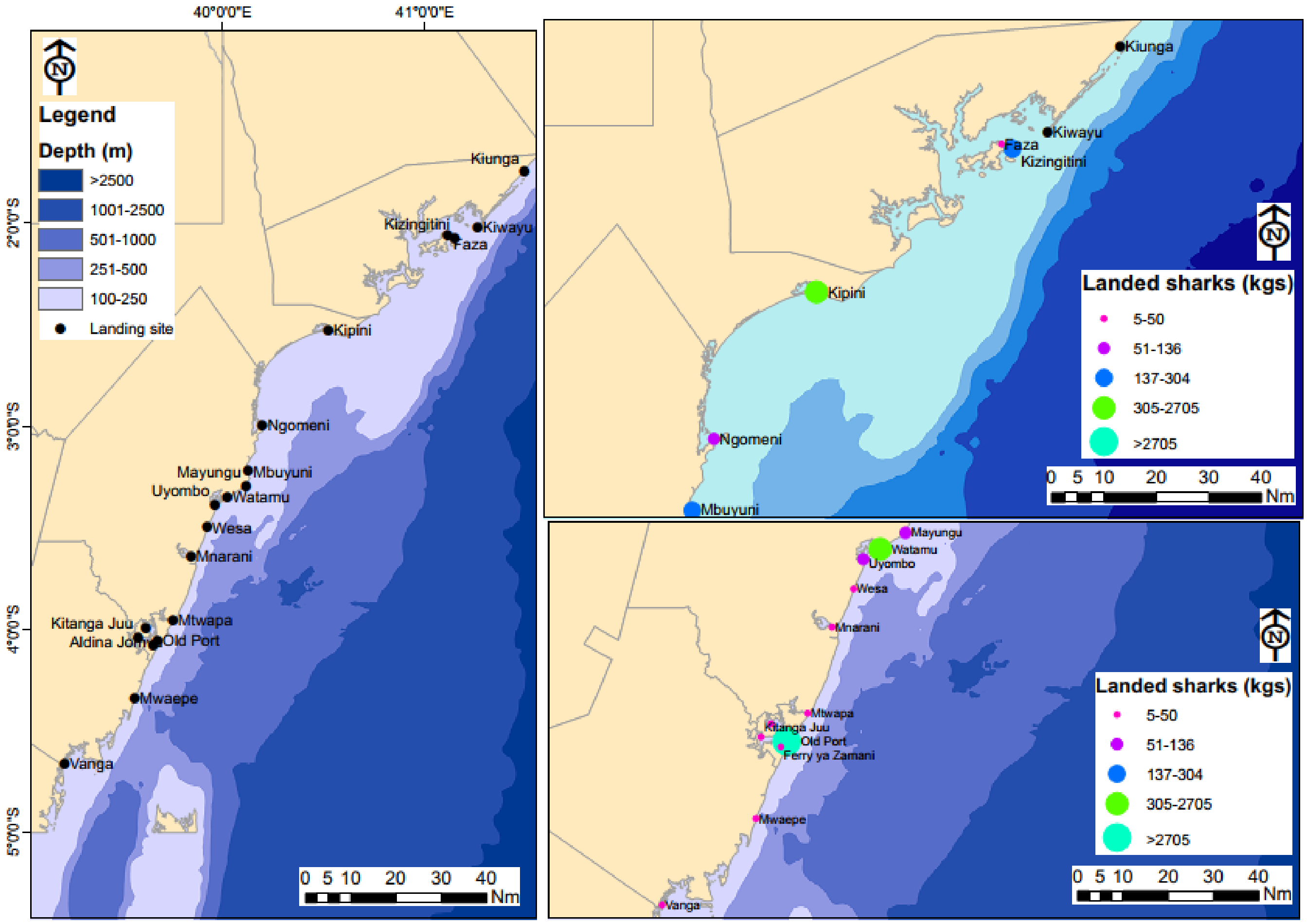


Figure 3. Main shark landings stations and estimated proportion of landed sharks (by weight) along the Kenyan Coast

Shark landings at the county level indicate that Kilifi lands the greatest catch in terms of weight at 1,011,556 M. Tons from the year 2014-2016 contributing to 56% of the total catch (Table 1). This was followed by Kwale at 21% of the total catch. Lamu and Mombasa county each contributed to 10 % of the total catch per county while Tana River county contributed to only 4% of the catch at 69,772 M. Tons. The families that contributed most to the landings were Carcharhinidae and Dasyatidae at 26%. Mylobatidae contributed to 13% of the catch whereas the families Sphyrinidae, Mobulidae and Rhinobatidae contributed to <5% of the catch. The category 'mixed species' contributed to 34% of the catch which highlights the need to increase capacity in the knowledge of taxonomy and identification of shark and ray species. There was also the possibility of misclassification between the families carcharhinidae and sphyrhindae

Table 1. Mean landed wet weight of sharks and rays in the Kenyan coast at the county level from the year 2014-2016. Source: KeFS.

Family (Common Name)	**Landed weight (MT)**					
	Kilifi	**Kwale**	**Lamu**	**Mombasa**	**Tana River**	**Total**
Carcharhidae (Sharks)	270,569	29,287	19,429	107,727	39,010	**466,022**
Dasyatidae (Sting rays)	343,697	78,180	22,457	14,985	3,144	**462,463**
Myliobatidae (Manta rays)	88,552	86,994	2,047	28,818	25,431	**231,842**
Sphyrinidae (Hammerhead sharks)	19,667	344	229	90	-	**20,329**
Mobulidae (Devil rays)	2,828	1,712	-	7,849	-	**12,390**
Rhinobatidae (Guitarfishes/skates)	485	-	-	-	-	**485**
Mixed species	285,759	180,957	135,036	5,533	2,187	**609,472**
Total	**1,011,556**	**377,474**	**179,198**	**165,002**	**69,772**	**1,803,003**

Table 2. Known shark species in catch landings in Kenya between 1989-1994 and 2007-2015. Numbers represent number of sharks caught.

Species Caught	**1989/90 [a]**	**1990/91 [a]**	**1991/92 [a]**	**1992/93 [a]**	**1993/94 [a]**	**2007[b]**	**2008[b]**	**2009[b]**	**2010 [b]**	**2011 [b]**	**2012/13[c,d]**	**2014/2015 [e]**	**TOTAL**	**IUCN Redlist category**
Saw fish, *Pristis microdon*	-	-	-	-	-	-	-	-	-	-	2	-	**2**	**CR**
Scalloped hammerhead, *Sphyrna lewini*	-	-	-	-	-	-	-	-	-	-	965	397	**1362**	**EN**
African spotted catshark, *Holohalaelurus punctatus*	-	-	-	-	-	-	-	-	-	-	13	-	**13**	**EN**
Spiny shark, *Squalus acanthias*	-	-	-	-	-	-	-	-	-	-	7	-	**7**	**EN**
Hammerhead *Spyrna* spp.	-	-	1	1	2	-	-	-	-	-	-	-	**4**	**EN**
Mako *Isurus* spp.	8	7	8	6	11	2,035	3,354	6,093	327	1	-	-	**11835**	**VU**
Smooth hammerhead shark, *Sphyrna zyggaena*	-	-	-	-	-	-	-	-	-	-	70	-	**70**	**VU**
Zebra shark, *Stegostoma fasciatum*	-	-	-	-	-	-	-	-	-	-	3	-	**3**	**VU**
Oceanic white tip, *Carcharhinus longimanus*	-	-	-	-	-	-	-	-	-	-	1	-	**1**	**VU**
Tiger shark, *Galeocerdo cuvier*	1	3	9	7	3	-	-	-	-	4	1	-	**24**	**NT**
Blue shark, *Prionace glauca*	-	-	-	-	-	2,427	4,408	3,514	695	-	-	-	**11044**	**NT**
Grey reef shark, *Carcharhinus amblyrhynchos*	-	-	-	-	-	-	-				233	223	**456**	**NT**
Blacktip reef shark, *Carcharhinus melanopterus*	-	-	-	-	-	-	-	-	-	-	59	101	**160**	**NT**
Blacktip shark, *Carcharhinus limbatus*	-	-	-	-	-	-	-	-	-	-	487	-	**487**	**NT**
Bullshark, *Carcharhinus leucas*	-	-	-	-	-	-	-	-	-	-	32	-	-	-
Silky shark, *Carcharhinus falciformis*	-	-	-	-	-	-	-	-	-	-	-	103	**103**	**NT**
Copper shark, *Carcharhinus brachyurus*	-	-	-	-	-	-	-	-	-	-	-	32	**32**	**NT**
Galapagos shark, *Carcharhinus galapensis*	-	-	-	-	-	-	-	-	-	-	2	-	**2**	**NT**
Crocodile shark, *Pseudocharias kamoharai*	-	-	-	-	-	-	-	-	-	-	3	-	**3**	**NT**
Blackspot shark, *Carcharhinus sealei*	-	-	-	-	-	-	-	-	-	-	1	-	**1**	**NT**
Yellowspotted catshark, *Scyliorinus capensis*	-	-	-	-	-	-	-	-	-	-	1	-	**1**	**NT**
Shortnose spurdogg, *Squalus megalops*	-	-	-	-	-	-	-	-	-	-	9	-	**9**	**DD**
African angelshark, *Squatina Africana*	-	-	-	-	-	-	-	-	-	-	4	-	**4**	**DD**
Smallfin gulper shark, *Centrophhorous muloscensis*	-	-	-	-	-	-	-	-	-	-	1	-	**1**	**DD**
Shark, Other	4	5	5	9	4	200,538	63,238	34,393	-	55	-	-	**298242**	
TOTAL	**13**	**15**	**23**	**23**	**20**	**205,000**	**71,000**	**44,000**	**1,022**	**60**	**284**	**881**	**322341**	

Source: [a]Marshall, 1997[b] Wekesa, 2012 [c] Kiilu and Ndegwa, 2013, [d]Kiilu et al., 2019, [e]Oddenyo, 2017, Temple et al, 2017. Key: CR-Critically Endangered, EN-Endangered,VU--Vulnerable, NT-Near Threatened, DD-Data Deficient

2.3 Shark Catches in recreational fisheries

Most species of sharks recorded in recreational fisheries are caught using rod and reel. Out of 18 species of sharks documented to date, the black tip shark (*Carcharhinus limbatus)* is the most caught species followed by the Whitetip reef shark (*Triaenodon obesus*) and silver shark (*Carcharhinus albimarignutus)* respectively (Fig. 4).

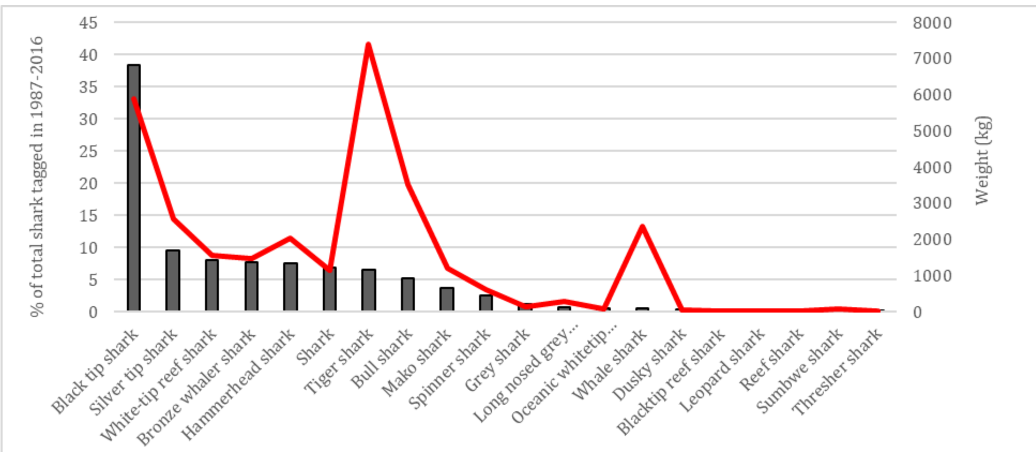


Figure 4: Trends of percentage sharks tagged in recreational fisheries (1987-2016) and weight (kg). Source: African Billfish Foundation (ABF).

Further analysis of the shark tagging data showed that months of August – December had relatively high quantities of shark catches based on total weight (Fig. 5). This could possibly imply increased productivity for sharks in during these months, but there is need for additional assessment to examine the factors that influence this observation.

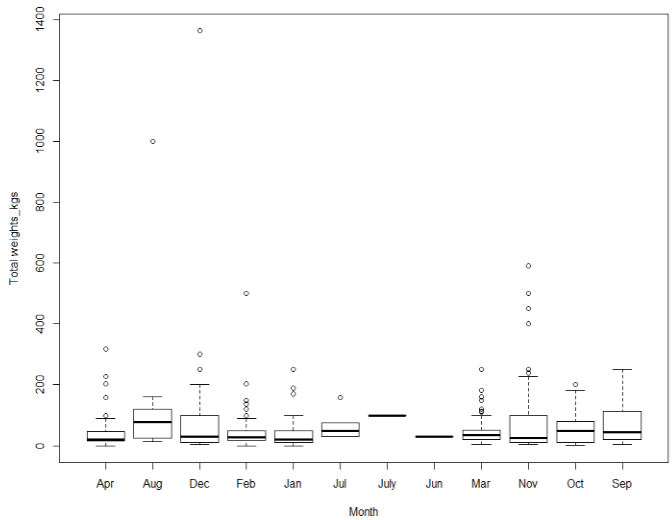


Figure 5: Monthly weight of sharks tagged from recreational fisheries; data from 1987 - 2016. Source: African Billfish Foundation (ABF)

To date 545 species of sharks have been tagged by Kenyan recreational fisheries using the African Billfish Foundation tags. Notable recaptures of tagged sharks from Kenyan waters have been recorded in places as far as the Seychelles (two recaptures of Silky shark).

2.4. Fishing dynamics

Sharks are captured by a diversity of fishing crafts and gears along the Kenyan coastline. These crafts and gears are outlined below. Their names are in the native Swahili language hence the italics. English names are in brackets.

2.4.1 Fishing craft and gears used in capturing sharks

a. Dau

This is a flat-bottomed fishing craft with ribs at the bottom and pointed at one end. Sharks contributed to a high portion of the catch taken by dau in the year 2012, at 26% (Fig 6). It is common in Tana River and Malindi where rivers Tana and Sabaki drain into the sea and have no coral reefs due to siltation. Due to the flat nature of its bottom, it's an ideal craft for area with muddy bottoms especially at the shore. In the year 2016, *dau* contributed to 13% of the total number of crafts that captured sharks.

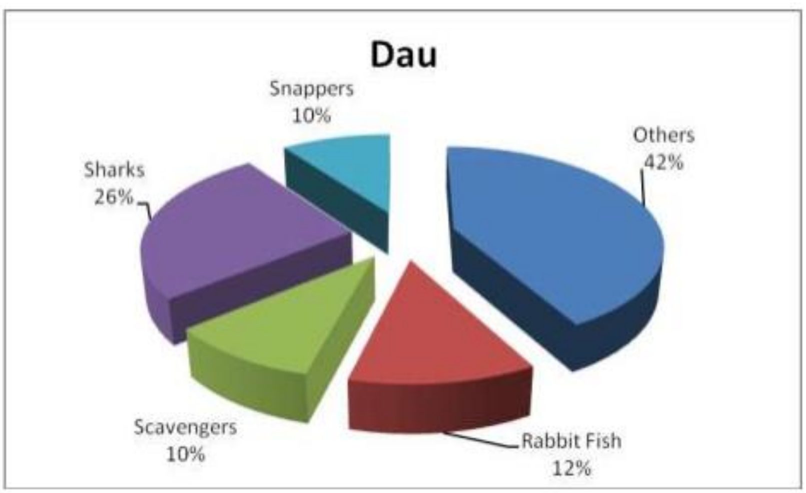


Figure 6. Main target species for Dau fishing craft in 2012. Source: KeFS.

b. Hori

Hori is a flat-bottomed fishing boat pointed at both ends used mostly in the shallow waters propelled by sail/paddles. It is strengthened by ribs (*mataruma*) on sides and the floor. The large sized *hori* craft are used outside the reefs and in the year 2012 captured sharks at 15% of their total catch (Fig. 7). *Hori* contributed to 11% of all the crafts that captured sharks in the year 2016.

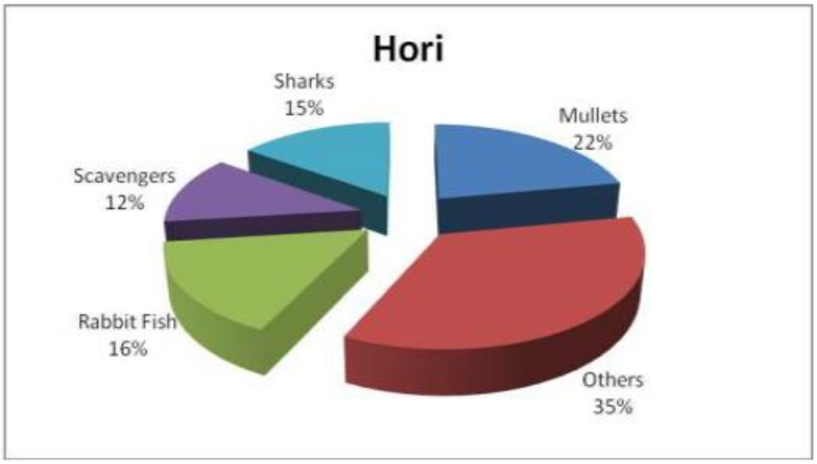


Figure 7. Main target species for Hori craft in 2012. Source: KeFS.

c. *Mashua*

Mashua, a craft pointed on one end V-shaped bottom and sail propelled or engine, were the main craft type that captured the sharks in 2012 (Fig. 8). This is due to the large size and ability to exploit far away fishing grounds. Apart from sharks at 26%, they also targeted other pelagic especially tuna and kingfish the three species constituting 48% of the main target species for the craft. The crafts are also popular with the lobster fishers as many fishers can fit into one vessel during the fishing expedition. In the year 2016 *Mashua* was the most prominent craft used in capturing sharks and rays at 53% of the total crafts.

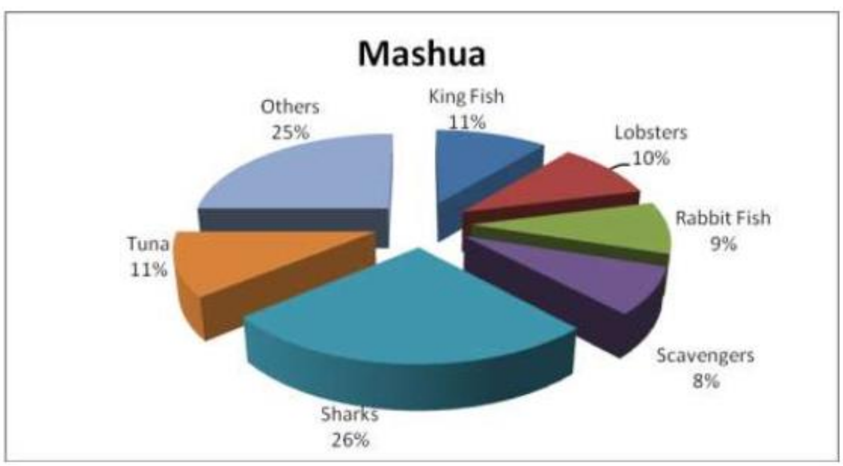


Figure 8. Main target species for mashua fishing craft. Source: KeFS.

d. Mtori

Mtori, are crafts with V- shaped bottoms pointed at both ends and ribs propelled by an outboard Engine/or sail and, are mainly found in Lamu. They mainly used by fishers who catch lobsters at 28% and sharks at 24% based on the 2012 marine frame survey. In the year 2016, *Mtori* contributed to 5% of the craft that captured sharks and rays. During the SE monsoons when exploitation of the fishing grounds outside the reefs are difficult, they are used by fishers who target such reef species as scavengers and rabbitfishes (Fig. 9).

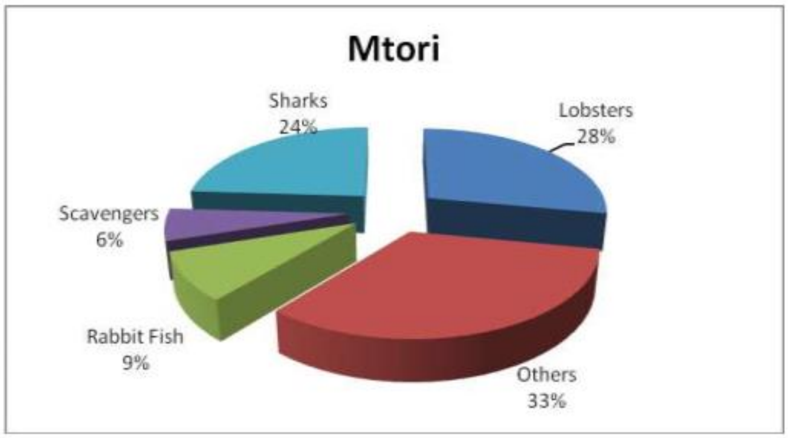


Figure 9. Main target species for mtori fishing craft. Source: KeFS.

2.4.2 Shark landings by gear

Different gears are known to target or catch sharks as bycatch based on the operation of the gear. The mode of operation and other details are described in Samoilys et al. (2011).

Gillnet contribute the highest proportion (62%) of the gears that target or catch sharks according to marine frame survey 2016 most common gear. Historically, gill nets have been the major gear used in targeting sharks in areas such as Kiunga. However, over the past four decades, a decline of 85% in shark catches has been noted and is attributed to the use of gillnets (Samoilys and Kanyange, 2008). Other gears that capture sharks include long lines at 23%, monofilament nets at 10%, hand lines at 3% and fence traps at 2% (Fig. 10).

The two gears most used in targeting sharks, gillnets and long lines, vary at the county level. Gillnets are mostly used in Lamu, Kilifi and Kwale counties at 97%, 54% and 43% respectively. Long lines are mostly used in Mombasa, Tana River and Kwale counties at 78%, 50%, and 50%, respectively (Fig. 11).

a. Gill net

The 2016 frame survey results and even those of previous surveys indicated that gillnet fishery is more of set gillnets accounting for 50% or 1,925 gillnets, or drift gillnets which account for 40% or 1,531 pieces. Very few are actively used, 10%, or 379 gillnets. This is also being studied under the BYCAM MASMA project https://bycamwio.weebly.com/

From the 2016 frame survey results, the 6-inch mesh sizes gillnets are the most common and catch a wide variety of species (Samoilys et al. 2017) but not shark species (CORDIO unpublished data). 668 of the total 3,835 gillnets (17%) captured sharks with single vertical panels of 4 – 6 inches which were mainly set gillnets in the 2016 marine frame survey (Fig. 12).

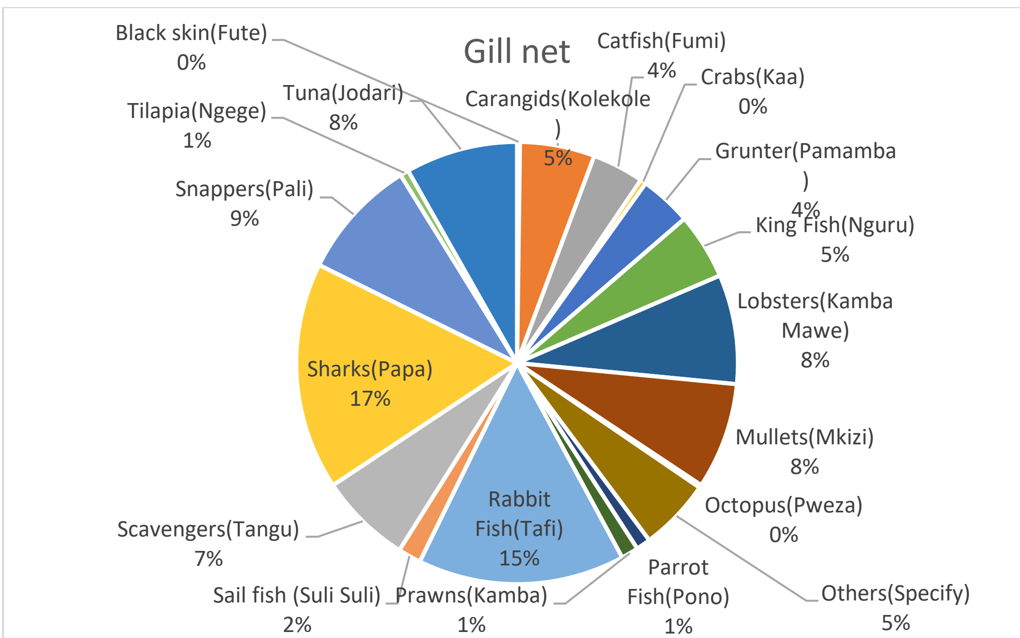


Figure 12. Proportions of species captured by gill nets in the year 2016. Source: KeFS

b. Long line

The 2016 marine frame survey indicates that most longlines hooks were used to capture sharks (37%) and snappers (23%) (Fig 13).

The distribution in use of longline hooks during the frame survey 2016 indicate that over 80% of hook sizes used in Kilifi County are size <4 (1,126 hooks) and size 4-7 (1,334 hooks). In Lamu County; most of the hooks are size 4-7 (2,695 hooks or 58%) and size 8-10 (1,790 hooks or 38%). Mombasa County has the highest number of longline hooks and the most common used hooks are size 4-7 (3,487 hooks or 64%). Size 4-7 and size 8-10 are used across all Counties during the last six frame surveys while in 2016, size < 4 hooks are used in Kilifi (1,126), Mombasa (520), Lamu (49) and Kwale (41).

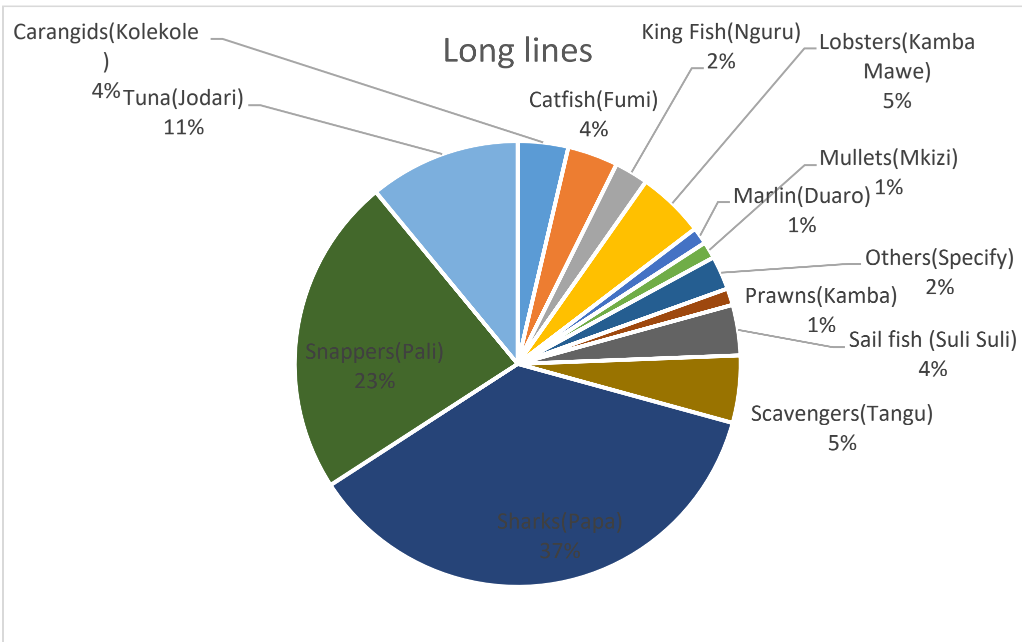


Figure 13. Proportions of species captured by long lines in the year 2016. Source: KeFS

c. Handline

Hand-line referred to single twine on which baited hook(s) is/ are attached. It can also include a stick onto which a hook is attached. Fishers have modified the traditional handline with one hook to the use of a handline with 7 – 9 hooks especially targeting deep water demersal species above 40nm offshore.

Handlines catch a variety of both targeted and incidental species including sharks. In 2014 Marine Frame Survey, sharks represented <1% of the catch (Fig. 14). In Ziwayuu Island and Kipini village, Tana River county sharks are majorly caught as bycatch with the handline gear (Oddenyo, 2017).

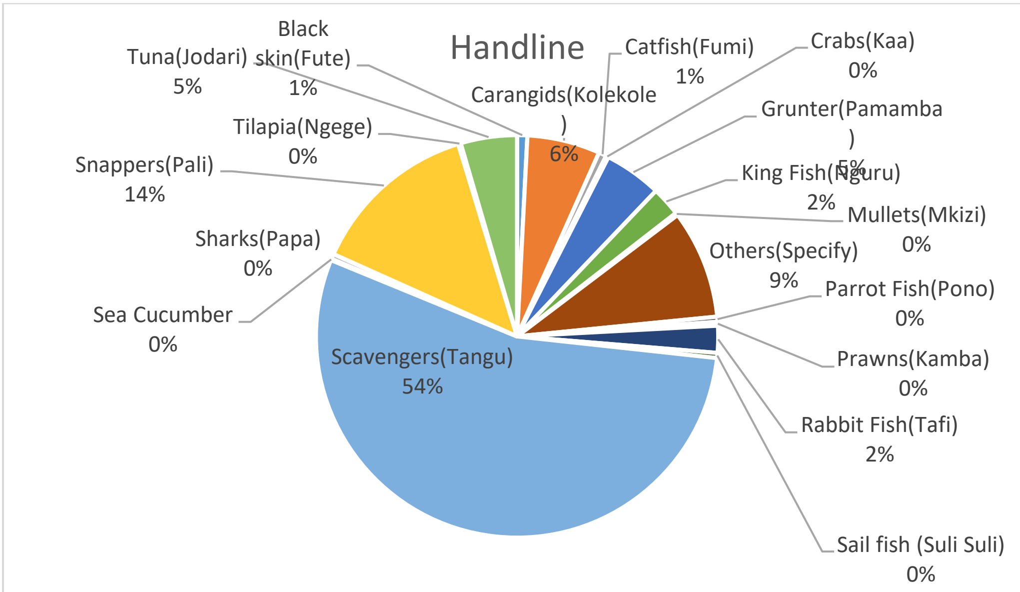


Figure 14. Proportions of species captured by hand lines in the year 2016. Source: KeFS.

3.0 SHARK FISHERY STOCK STATUS AND BIOLOGY

3.1 Stock status

To date, there have been no stock assessment for shark species in Kenya. However, a recent study on growth and reproductive parameters of four shark species in Kipini and Ziwayuu Island (Fig. 2), found differences in sex ratios in the landings suggesting sex-specific movement of some species to the fishing grounds locations (Oddenyo 2017). Females of *S. lewini* species were more frequently caught in which could lead to recruitment failure whereby most females are eliminated from the population resulting in a decrease in mature females that would reproduce in the next recruitment year. 36% of female and 63% of male *C. amblyrhynchos* (grey reef shark) were caught at sizes less than L_{opt}. Ninety eight percent (98%) of *S. lewini* (scalloped hammerhead shark) landed were smaller than L_{opt}). For *C. melanopterus* (grey reef shark), 95% of the specimens landed were less than L_{opt}. *C. falciformis* (silky shark) had lengths larger than L_{opt} (Table 3).

Table 3. Growth parameters of sharks landed at Kipini following Froese and Binholan (2000) empirical equations. (L_{max}, maximum observed length; L_{∞}asymptotic length; L_m, mean length at first maturity; L_{opt}, length at maximum possible yield per recruit and < L_{opt}, proportion less than length at maximum possible yield per recruit) Source: Oddenyo, 2017.

SPECIES	L_{max} (cm)	L_{∞} (S.E. range) (cm)	$L_m$female (S.E. range)(cm)	$L_m$male (S.E. range) (cm)	L_{opt} (S.E. range) (cm)	< L_{opt} (%)
Sphyrna lewini (Scalloped hammerhead shark)	254	257.4 (217.1-305.2)	146.7 (110.6-194)	111 (79.2-155.9)	172.9 (146.2-204.6)	98
Carcharhinus amblyrhynchos (Grey reef shark)	133	136.2 (114.8-161.5)	80.3 (60.6-106.3)	63 (44.9-88.4)	89.1 (75.3-105.4)	46
Carcharhinus falciformis (Silky shark)	132.5	135.7 (114.4-160.9)	80 (60.4-106)	62.8 (44.8-88.1)	88.7 (75-105)	0
Carcharhinus melanopterus (Blacktip reef shark)	127.5	130.6 (110.2-154.9)	77.2 (58.3-102.2)	60.7 (43.3-85.1)	85.5 (72.1-100.9)	95

3.2 Biology of sharks

3.2.1 Feeding Ecology

The generally high percentage indices of relative importance (%IRI) for fishes in the diet of species are indicative of the highly piscivorous nature of sharks (Oddenyo, 2017; Daly *et al*., 2013) (Fig. 15). The large contribution of crustaceans in the diets of the grey reef shark and the silky shark suggest that teleost fishes may be supplemented by invertebrates as prey in some species in the Malindi-Ungwana bay area (Oddenyo, 2017).

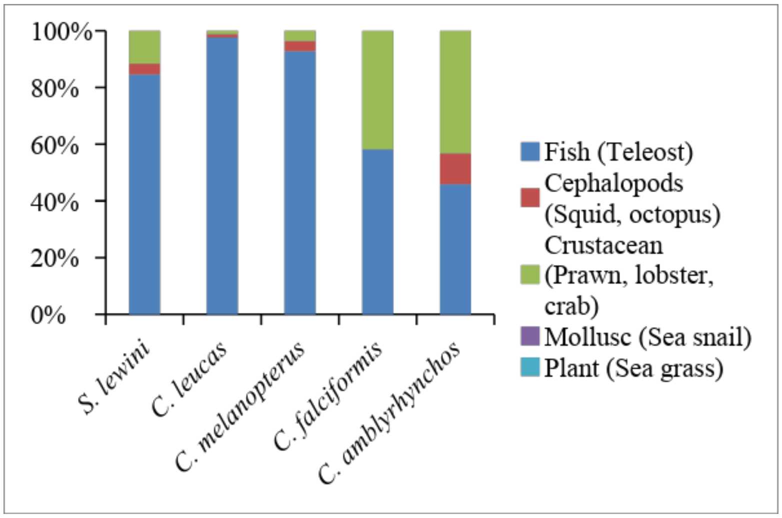


Figure 15. Percentage Index of Relative Importance of prey items consumed by sharks caught on the Kenyan Coast. Source: Oddenyo, 2017

The scalloped hammerhead and blacktip reef and bull sharks have a narrow niche breath suggestive of specialized feeding strategies adopted by these species. Significant interspecies overlaps in diet existed between the scalloped hammerhead, bull, grey reef, copper and blacktip reef sharks in the Malindi-Ungwana bay area indicating likely high competition for food resources (Oddenyo, 2017). Narrow niche breadths and diet overlaps may restrict growth rates if food items become scarce in the environment or if climate induced variability in abundance occurs (Oddenyo, 2017). However, the generalist species; the grey reef shark and the silky shark may suffer less from prey variations in the environment.

Trophic levels (TL) of sharks landed ranged from 3.90-4.238 indicating them as apex predators with the bull shark registering the highest trophic value of 4.238 and the silky shark the lowest at a value of 3.90 (Oddenyo, 2017).

3.2.2 Exploitation rates, mortality rates, length frequencies, size at maturity, breeding, growth rates, CPUE, MSY

a. Growth, mortality, exploitation rates and recruitment patterns of sharks

Kiilu et al. (2019) reported in *S. lewini* a total mortality, Z, of 1.69 yr^{-1} which is high compared to 0.56 yr^{-1} mortality rate observed by Liu and Chen (1999) for the species in

Northwestern Pacific. The high total mortality of *S. lewini* in Kenya is likely related to the juvenile composition of the specimens in the landings that could eventually lead to recruitment overfishing and raise the fishing mortality. *S. lewini* have been reported to be exploited beyond optimum levels (E= 0.6), indicating that increasing fishing pressure on its fishery is not sustainable for the species in the long run (Kiilu et al., 2019). The exploitation rate of *C. limbatus*, *C. melanopterus*, *C. amblyrhynchos* and *C. leucas* seem to be below optimum levels at E< 0.5 (Kiilu et al., 2019). The juveniles are vulnerable to the gill nets and beach sein nets of artisanal fishermen who fish close to the shore in the estuaries and bays, and this may lead to the danger of recruitment overfishing (sensu Pauly *et al*., 1998) and stock collapse (Kiilu, 2016).

b. Shark fin-body weight relationships and ratios

Studies of The fin weight-bodyweight ratio for *S. lewini and C. limbatus didtributed across the Kenyan waters was estimated* at 7.4% (n= 479) and at 5.7% (n=280)which is slightly higher than the universally used threshold ratio of 5%. This indicates that the ratio may vary between species (Kiilu, 2016). The fin-weight to body-weight linear relationships reported for *S. lewini* and *C. limbatus* suggest that fin-weight (a commercial product) is a good predictor of body weight in the two species (Kiilu, 2016) and hence useful in compliance aspects.

3.3 Sharks in Marine Protected Areas

Marine protected Areas have been established in Kenya to protect and conserve marine and coastal biodiversity and managed by Kenya Wildlife Service (KWS) There are four no-take marine national park that are protected from any form of extractive activities. There are also six national reserve mostly around the parks that allow traditional fishing activities and act as a buffer zone for the parks. No-take MPAs in Kenya have been acknowledged as successful in restoring fish biomass and biodiversity and have been cited as the most effective in the region (McClanahan et al, 2007). However, reserve have run short of their objectives with high exploitation rate and use of destructive and illegal gears experienced and almost with no difference with fished areas (Samoilys and Obura, 2011).

In recent years, marine conservation has moved to a more collaborative management approach through adopting Locally Managed Marine Areas (LMMA) mainly for fisheries and other marine resource management (Rocliffe et al. 2014). In the last decade 24 LMMAs have been established in the country with varying levels of protection (McClanahan et al, 2016; Kawaka et al, 2017).

There is limited information available on sharks in marine protected areas in Kenya. Elasmobranch assessment has been carried out in Watamu Marine National Park and Reserve, the oldest protected area in the country. Thirteen species of elasmobranchs representing 8 families were recorded from Underwater Visual Census (UVC) and Baited Remote Underwater Videos (BRUVs) including juveniles of three of them (Table 4). The survey also observed five of these species in fisheries catches around the reserve as by-catch. Anecdotal information also reported sightings of tiger shark (Galeocerdo cuvier) around the area specifically by deep sea recreational fishers (Musembi et al, 2017).

Table 4. Shark species identified in the Watamu Marine National Park.

Family	**Species**	**IUCN Redlist category**
Sharks		
Carcharhinidae	*Carcharhinus melanopterus*	Near Threatened
Carcharhinidae	*Triaenodon obesus*	Near Threatened
Rhincodontidae	*Rhincodon typhus*	Vulnerable
Rays		
Myliobatidae	*Aetobatus narinari*	Near Threatened
Dasyatidae	*Himantura uarnak*	Vulnerable
Dasyatidae	*Neotrygon kuhlii*	Data Deficient
Dasyatidae	*Pastinachus sephen*	Data Deficient
Dasyatidae	*Taeniura lymma*	Near Threatened
Torpedinidae	*Torpedo sinuspersici*	Data Deficient
Mobulidae	*Mobula Kuhlii*	Data Deficient
Mobulidae	*Manta alfredi*	Vulnerable
Guitarfishes		
Rhinidae	*Rhina ancylostoma*	Vulnerable
Glaucostegidae	*Glaucostegus halavi**	Vulnerable

*An unknown guitarfish is thought to be *Glaucostegus halavi* (Melita Samoilys and Rima Jabado), although the species is only known from the Red Sea, Persian gulf and India.

4.0 SHARK TRADE AND MARKETS

4.1 Global shark catch and markets

The global values of shark landings from the FAO Fisheries Commodities database (FAO, 2010) rose from around US$400 million in 1990 to over US$1 billion in 2000, declining to around US$800 million in 2006. Because of the low economic value of sharks and rays, few resources have been put into the collection of fisheries landings data (FAO, 2010).

4.2 Domestic markets for shark products

The Kenyan and Tanzanian markets for shark meat are substantial and Kenya imports shark meat from neighbouring countries (Barnett, 1996). Important transhipment ports for dried shark fins include Kenya and South Africa in Africa although the UAE and Yemen also appear to be important transhipment hubs (McCoy and Ishihara, 1999).

4.2.1 Trends in export and imports of shark products

Shark fin exports in Kenya between the years 1990 to 1995 indicated a steady decline from 10 mt in 1990 to 4.3 mt in 1995 (Fig. 16) (Kenya Fisheries Service data). The total weight of shark fin exported between 2006 and 2015 fluctuated with a high 31.2 mt in 2008 to a low of 5.6 mt in 2012. There has been a gradual increase in shark fin exports from 2012 to 2015 (Fig. 16) (Kenya Fisheries Service data).

The value of shark fin in terms of KES/Kg showed a rise from KES.187/Kg in 1987 to KES. 824/Kg in 1992 (Kenya Fisheries Service data). There was also a rise in value between 2006 to 2015 with the lowest registered export value of KES.31.9/Kg in 2008 to the highest most recent value of KES.721.6/Kg registered in the year 2015 (Fig. 16) (Kenya Fisheries Service data).

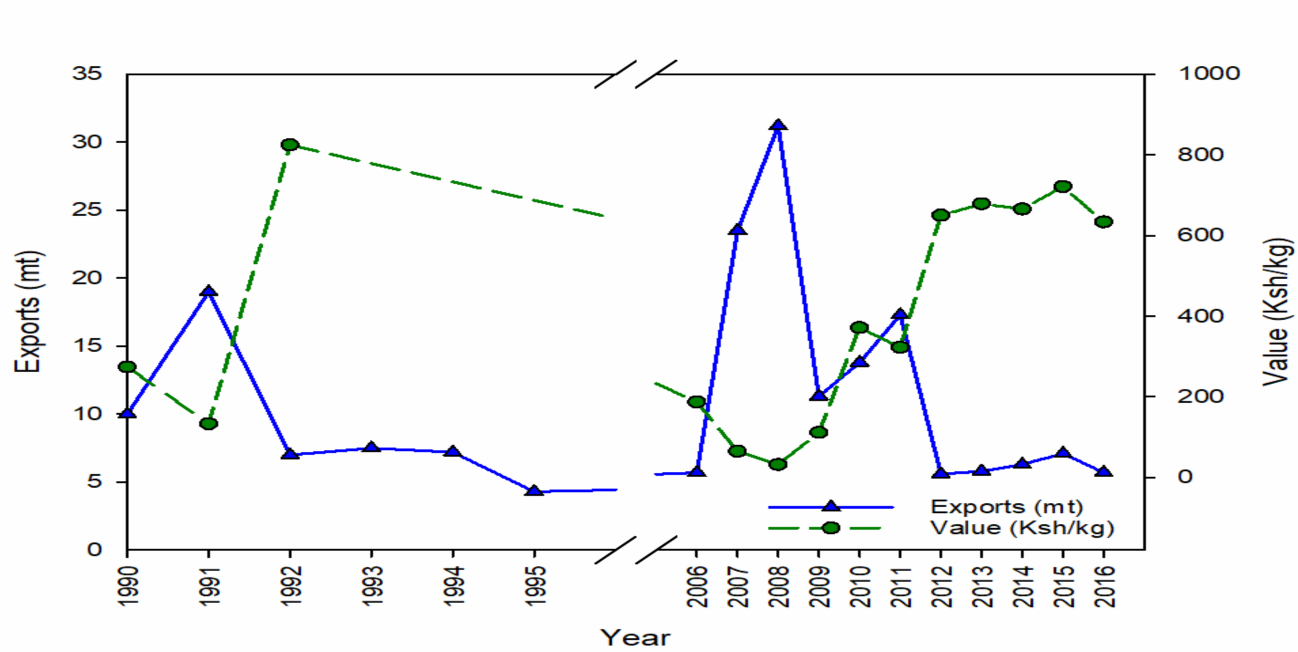
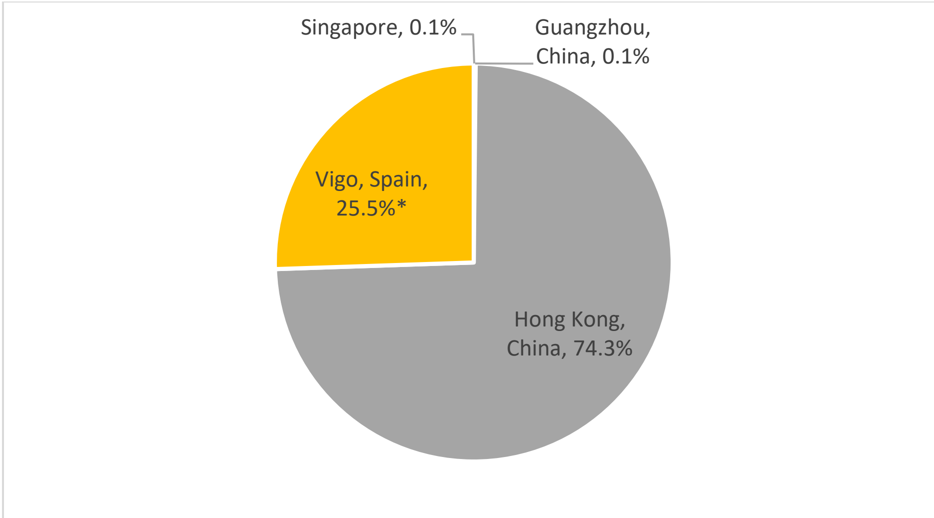


Figure 16. Shark fin exports in metric tons and value in KES/Kg between 1987-1995 and 2006-2015. Source: KeFS

4.3 Markets for other shark products

4.3.1 Shark fins

For the period between 2006 and 2015 the largest importer of shark fins/tails from Kenya was Hong Kong, China with a total of 53.9 mt (74.3%) (Kenya Fisheries Service data). This was followed by, Spain at 18.5 mt (25.5%), all of which were frozen. Singapore and China registered minimal imports of shark fin from Kenya at 54 Kgs (0.1%) and 60 Kgs (0.1%) respectively (Fig. 17). Shark fin exports to China and Singapore were dried as a means of preservation (Kenya Fisheries Service data).



*Frozen shark fins/tails were multiplied with a correction factor of 0.25 according to Clarke (2004). Source: KeFS.

Figure 17. Proportions of shark fin/tail biomass exported to various destinations from 2006-2015 from Kenya. Source: KeFS

Markets for shark meat, cartilage, skin, liver oil and fins exist in Africa and the Middle East (Barnett, 1996). Dried and salted shark meat is common as it provides a convenient form in which to transport the product in areas where shelf-life would otherwise be limited (Vannuccini, 1999).

4.4 By-products associated with directed or target shark fisheries

By-products from sharks include carcasses, fins, liver, skin, cartilage and jaws. Carcases are used as a source of protein whilst fins are majorly traded in international market for fin soup.

Shark liver in the artisanal fisheries to coat boat hulls to prevent biofouling. Shark skin has been used as a material in making wallets and bags. Cartilage obtained from sharks has been used in the development of glue. On the other hand, shark jaws are mainly collected as souvenirs by local and international tourists. Despite the anecdotal knowledge on the use of various shark by-products, little is known about their value chain and socioeconomic significance in the country.

4.5 Shark fishery value chain

Sharks caught by artisanal fishers in Kenya are sold in the local markets through a variety of market chains. These include fishers selling directly to consumers; fishers to traders and middlemen; and fishers to retailers. Sharks are either sold fresh, deep fried or salted and sun dried.

4.6 Tourism

Sharks also play a role in ecotourism and recreation globally in the form of sports angling, or game fishing (Clarke *et al*., 2005). Whale sharks and manta rays form part of the dive tourism in some areas like Watamu, although they are sighted seasonally especially from November to January. Anecdotal information from dive operators in Watamu suggest a decline in shark sightings in the last two decades. Whale sharks and manta ray sightings have reduced in the past several years (Musembi *et al*, 2017).

4.7 Socioeconomic significance of sharks and rays to coastal communities in Kenya

Information on the socio-economic significance of sharks and rays to the local livelihoods is inadequate.

However, a recent first-time study conducted by KMFRI under the BYCAM project provides some baseline findings on the socio-economic importance of sharks and rays along the Kenya coast. The project study sites included Kiunga, Kizingitini, ~~Mashamasha~~, ~~Kitau~~, Kiwayu, Kipini, Mareroni, Bamburi, Gazi, Mwaepe, Mkunguni, Shimoni and Vanga. Preliminary results indicate that sharks and rays comprise various proportions of catch in weight at different landings sites with the largest proportions caught at Mkunguni (~70%) followed by Kaleloni (~40%) (BYCAM, unpublished data). Lower proportions of catch were reported for Kiwayu, Kizingitini, ~~Mashamasha~~, ~~Mareroni and Kitau~~ sites ranging between 10-30% of the catch in terms of weight (Fig. 18a) (BYCAM, unpublished data).

Respondents in Shimoni were the only ones who mentioned rays to be part of their catch contributing to 30% of their total catch in kilogrammes (BYCAM, unpublished data) (Fig.18b).

Figure 18. Proportions in kilograms of the total catch at selected landing sites of a) sharks and b) rays. Source: BYCAM, unpublished data. (To be updated)

4.7.1 Livelihoods

Fishing has been reported as the main source of income for most coastal communities contributing to > 80% of their household income. In Kiunga, 100% of income was from fishing (BYCAM, unpublished data) (Table 5). In Mkunguni, Kizingitini and Shimoni sites where sharks and rays were reported to contribute large proportions of the total catch, respondents indicated that ~87% of their income was obtained from fishing (Table 5). All fishers were above 35 years of age while the level of education ranged between 6 years and 3 years (Table 5). The number of members per household ranged between four and five with Kizingitini having the largest household size at ~5 members per household (BYCAM, unpublished data).

Table 5. Social metrics obtained from communities in selected sites along coastal Kenya. Source: BYCAM, unpublished data.

Landing sites	Age of respondent	Level of education	Years in fishing	Household size	Contributors per HH	Fishers per HH	% Income from fishing	Origin-% locals
Bamburi	49.4	6.2	25.8	2.5	1.6	1.1	88.6	54.5
Gazi	43.1	4.4	27.5	2.5	1.4	0.9	87.7	73.3
Kipini	39.4	3.5	17.9	3.4	2.3	1.3	79.5	42.9
Kiunga	51.8	2.7	36.2	4.2	1.8	2.0	100.0	100.0
Kiwayu	42.5	4.7	21.1	3.1	2.4	1.1	94.4	100.0
Kizingitini	52.2	3.9	30.4	4.8	1.7	1.4	85.8	100.0
Mkunguni	42.8	3.0	33.4	2.9	1.5	0.8	86.7	10.0
Mwaepe	47.3	4.2	25.3	2.9	1.9	1.2	86.9	13.8
Shimoni	51.5	5.0	22.5	2.7	1.6	1.2	87.1	3.2
Vanga	42.5	3.6	18.7	2.4	1.7	1.3	90.4	19.2

Farming, fishing related activities, small-scale trading and tourism activities were reported as alternative livelihoods in all the sites surveyed (BYCAM, unpublished data). There were fewer alternatives in the north coast sites, with an average of three including casual jobs, farming and animal husbandry in Kizingitini and Kiwayu. Kipini stood out as a site with numerous alternative livelihoods in the North Coast totalling 10 and may be due to the location of the site at the location where River Tana flows into the Indian Ocean. Respondents interviewed in Kiunga fully relied on fishing and failed to mention any alternative livelihoods (BYCAM, unpublished data).

Alternative livelihoods undertaken by community members were site specific, for example, in Mkunguni the main alternative livelihood mentioned was farming and animal husbandry whereas in Shimoni tourism was mentioned most. Farming and animal husbandry was mentioned as alternative for a majority of the sites surveyed (BYCAM, unpublished).

4.7.2 Perceptions on shark and rays

Catch trends

Community members were interviewed on how they perceived changes in shark and ray catches through time by stating whether they increased, decreased or were the same (BYCAM, unpublished). Majority of the respondents stated that catches had decreased over time. Based on these findings, some of the factors affecting the catch and value of sharks and rays included: (i) seasonal variation, (ii) technological changes, (iii) overexploitation, (iv) inadequate enforcement of regulations for sustainable practices, (v) lack of proper gear, (vi) availability of markets and demand for sharks and by-products and (v) natural /supernatural phenomena (BYCAM, unpublished)

7.0 DISCUSSION

Kenya has a diverse composition of sharks and rays in its marine waters which provide a wide array of ecosystem values and services. However, there are a number of threats that currently face sharks and rays. These include harvesting of juveniles in the artisanal fishery of species such as *S. lewini* and *C. melanoterus* with >90% of their catch being below the length corresponding to age at maximum sustainable yield per recruit, there is also the exportation of fins in the international markets as Hong Kong and Spain. Sharks caught in the artisanal fishery are mainly utilised locally as a source of protein. They are either sun dried and salted, frozen or deep fried as a means of preservation. Fins are normally stored separately due to their value and are later sold in the international market.

Results of the yearly Marine Frame Surveys undertaken by the KeFS suggest that sharks comprise ~25% of the catch in the *dau*, *mashua* and m*tori* vessels. In terms of gears targeting sharks, a recent survey conducted in 2016 found that 668 of a total of 3,835 gillnets targeted sharks. Similarly, the largest proportion of catch in longlines was sharks at 37%. Handlines and the illegal monofilament net caught <5% of sharks in the year 2016.

Shark fins obtained in the Kenyan fishery have an international market in Hong Kong, Guanzhou, Spain and Singapore as evident from KeFS records. The largest importer of shark fins/tails from Kenya was Hong Kong, China totaling to 53.9 mt. Information of the species of sharks and rays from which the fins are obtained is however sparse.

With regard to the management and conservation of sharks rays, Kenya participates in several international and regional organizations and bodies concerned with fisheries in order to attain the sustainable use of these resources. At a national level Kenya's approach to managing its fisheries and oceans resources is based on a constitutional commitment to ecological sustainability (Constitution of Kenya 2010; Part 2- Land and Environment), integrated fisheries management (Fisheries Development and Management Act, FMDA-2016), and the precautionary approach (FMDA 2016; National Oceans and Fisheries Policy 2008).

Kenya has domesticated resolutions made by IOTC members on the conservation, management and transhipment of sharks and rays in the FMDA, 2016 and by extension the

Draft Fisheries Regulations. However, no fisheries conservation and management measures are in place for any of the hammerhead sharks already in Appendix II of the CITES and that are substantially harvested as juveniles in Malindi-Ungwana bay, or any other sharks and rays, whether in Appendix I and II of the CITES. This gap shall therefore be sufficiently addressed in this NPOA- Sharks. The same NPOA- Sharks will also address the harvesting and trade in controlled shark species, the harvesting and trade of which is currently based on solely expert opinion of the fisheries managers of the KeFS.

Harvesting of sharks and rays for aquaria is largely unregulated, and more data is required to make conclusive and informed decisions on the shark stocks. In the meantime, the precautionary approach towards their management and other appropriate management measures need to be complied with.

8.0 GAPS ESTABLISHED IN THE BASELINE ASSESSMENT REPORT AND THEIR RECOMMENDED MANAGEMENT ACTIONS

The following gaps and recommended management actions were established based on the assessment of sharks in Kenya as of 2018 (Table 6):

Table 6. Gaps and recommended management actions for sharks in Kenya

Gaps	Recommended management actions
Collection and, as appropriate sharing, in a timely manner complete and accurate data and information concerning sharks.	Streamlining data collection protocols (species identification, data recording and management) in order to improve data quality and consistency Enhance shark fishery bycatch reporting Awareness creation.
The stock status of sharks and rays in the country has not been assessed for a majority of species.	An assessment of the status of shark and ray species in the country.
There is a lack of management measures for hammerhead sharks.	Enforcement of management measures with regard to hammerhead sharks with regulations in trade as an appendix II species in CITES.
Paucity of information on the value chain and trade of sharks.	Undertaking a value chain analysis to species level of shark products and by-products
Dealing with IUU enforcement and control.	Enforcement of existing regulations governing sharks under national legislation as well as regionally internationally ratified agreements.
A lack of information on interactions of the shark fishery with other fisheries and their linkages.	An evaluation of interactions of the shark fishery with other fisheries and their linkages.
Paucity of information on migrant fishers and their effects on sharks.	An evaluation of the effects of migrant fishers on sharks.
Biology and ecology of a majority of shark and	Conducting biological and ecological

ray species.	evaluations on shark and ray species.
There is a need for a risk assessment to be conducted on the implementation of a national plan of action for sharks.	Conducting a risk assessment on the implementation of a national plan of action for sharks based on the best available information.
The country does not have a National Plan of Action document for sharks in place.	Development of a National Plan of Action document for sharks based on the assessment report and risk assessment.

9.0 REFERENCES

Barnett R (1996) Shark Fisheries and Trade in East and Southern Africa. Pp. 329–339 in TRAFFIC Network. The World Trade in Sharks: a Compendium of TRAFFIC's regional studies. Volume I. TRAFFIC Network, Cambridge, UK.

Clarke S, Burgess GH, Cavanagh RD, Crow G, Fordham SV, McDavitt MT, Rose DA, Smith M, Simpfrendorfer A. (2005) Socio-economic significance of chondrichthyan fish. In Fowler SL, Cavanagh RD, Camhi M, Burgess GH, Cailliet GM, Fordham SV, Simpfendorfer CA, Musick JA (comp. and ed.). 2005. Sharks, Rays and Chimaeras: The Status of the Chondrichthyan Fishes. Status Survey. IUCN/ SSC Shark Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK. x + 461 pp.

FAO (2010) Global commodities production database www.fao.org/fishery/statistics/globalcommodities-production/query/en

FAO (2012) Review of the implementation of the international plan of action for the conservation and management of sharks. FAO Fisheries Circular No. 1076. Rome: Food and Agriculture Organization.

FAO (1996) FAO Technical Guidelines for Responsible Fisheries - Precautionary Approach to Capture Fisheries and Species Introductions – 2. Rome: Food and Agriculture Organization.

Fulanda B, Ohtomi J, Mueni E, Kimani E (2011) Fishery trends, resource-use and management system in the Ungwana Bay fishery Kenya. Ocean. Coast. Manag. 54, 401—414.

IUCN, 2018. The IUCN Red List of Threatened Species. Version 2017-3 www.iucnredlist.org Downloaded on 23 May 2018.

Kiilu, BK (2016). Distribution, abundance and some biological aspects of sharks (Pisces: Chondrichthyes) on the Kenyan coast. MSc thesis, Fisheries and Aquatic Sciences (Aquatic Resources Management), School of Natural Resource Management, University of Eldoret, Kenya.

Kiilu BK, Kaunda-Arara B, Oddenyo RM, Thoya P & Njiru JM (2019) Spatial distribution, seasonal abundance and exploitation status of shark species in Kenyan coastal waters, African Journal of Marine Science, 41:2, 191-201, DOI: 10.2989/1814232X.2019.1624614

Kiilu, BK, Ndegwa S (2013) Shark by catch – Small scale tuna fishery interactions along the Kenyan coast. IOTC-2013-WPEB09-13.

Marshall NT (1997) Trade in Sharks and Shark Products in Kenyan Waters. TRAFFIC East/Southern Africa, Nairobi, Kenya. In Marshall NT and Barnett R (eds). (1997). The trade in sharks and shark products in the Western Indian and Southeast Atlantic Oceans. TRAFFIC East/Southern Africa, Nairobi, Kenya.

McCoy MA, Ishihara H (1999) The socio-economic importance of sharks in the US Flag Areas of the Western and Central Pacific (Admin. Rep. AR-SWR- 99-01). Prepared for the US Department of Commerce, National Marine Fisheries Service, Southwest Region. Gillett, Preston and Associates Inc., USA.

Munga CN, Omukoto JO, Kimani EN, Vanreusel A (2014) Propulsion-gear-based characterisation of artisanal fisheries in the Malindi-Ungwana Bay, Kenya and its use for fisheries management. Ocean and Coastal Management 98 (2014) 130—139. Elsevier.

Musembi P, Cowburn B, and Sluka R. (2017). Biodiversity and Conservation of Elasmobranchs in Watamu Marine National Park and Reserve. A Rocha Kenya.

Musick JA (2005) Shark Utilization. In J. Musick and R. Bonfil, eds. Elasmobranch fisheries management techniques. pp. 223–236. FAO Fisheries Technical Paper. No. 474. Rome, FAO.

Obura D, Rowat D, Nicholas A, Pierce D (2013) Whale sharks in the Indian Ocean. Swara. October-December 2013. www.eawildlife.org.

Oddenyo, RM (2017). Trophic ecology and the exploitation status of sharks (Pisces: Elasmobranchii) in North Coastal of Kenya. MSc thesis, Fisheries and Aquatic Sciences (Aquatic Resources Management), School of Natural Resource Management, University of Eldoret, Kenya.

Pauly, D, Christensen V, Dalsgaard J, Froese R and Torres FC Jr. (1998) "Fishing down marine food webs." Science 279:860- 863.

Samoilys MA and Kanyange NW 2008. Natural resource dependence, livelihoods and development: Perceptions from Kiunga, Kenya. IUCN ESARO 2008.

Samoilys, MA (1988). Abundance and species richness of coral reef fish on the Kenyan coast: the effects of protective management and fishing. Proc. 6th int. coral Reef Symp. 2: 261-266

Vannuccini S (1999) Shark utilisation, marketing and trade. FAO Fisheries Technical Paper No. 389. FAO, Rome, Italy.

Wekesa PN (2012) Kenya National Report to the Scientific Committee of the Indian Ocean Tuna Commission. IOTC-2012-SC15-NR13.