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Seasonality, morphometrics and feeding behaviour of sailfish (*Istiophorus platypterus*) caught by sports fishers in the Kenyan waters

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Abstract

Sailfish (*Istiophorus platypterus*) are among the major target species caught by sports fishers in Kenyan waters. As a conservation measure, sports fishers return the fish to the waters and also tag them in an effort to study them. The retained fish are mainly those injured during the fishing expedition, they are brought on board and these were the ones used for the study which was conducted between November 2012 and January 2013 which is the peak season for sailfishes in the Kenyan waters. For seasonality data, a 19 year daily catch data from 1987 to 2011 was used. The December and January happen to have the peak abundance of sailfish in the waters. They average weight of the sailfish was recorded as 28.9 ± 4.4 kgs and had an average eye-orbit fork length of 166.5 ±9.5 cm. The major food contents in the fish stomachs were crabs (*Charybdis smithii*) sardines *Stolephorus commersonii (*Lacepède, 1803) and Kawakawa (*Euthynus affinis*).

Introduction

Large scale fishing in the Western Indian Ocean (WIO) had been low since the entry of the Japanese longliners in the 1950's. However, after the entry of the European purse seiners in the mid 80s, the exploitation of large pelagic fishes has been on the increase reaching the peak in 2005. The catches after that have been on a decline. This high exploitation of the resource could have brought about changes in the foraging behavior of the target species following concerted extraction. Such a removal of top predators could have repercussions on the food web structure through top-down, trophic cascades (Kitchell et al., 1999; Essington et al., 2002). Among the target species are the tunas and the billfishes. Our knowledge of the biological components and the predator–prey interactions in the Western Indian Ocean is still scarce despite increase in fishing effort.

Analysis of the stomach contents of marine top predators can be useful for many different investigations. Besides indicating what the predator depends on for food, the predator's distribution, diving prowess, foraging behavior and ecology (Clarke and Macleod, 1976; Clarke and Kristensen, 1980; Thompson et al., 1991), analysis of stomachs content can tell us about the ecology of the prey species, their distribution (Clarke, 1980; Potier et al. 2007), seasonal fluctuations and sometimes growth (Clarke, 1993).

Several studies have investigated the diet of large pelagic fish predators in the Indian Ocean. Watanabe (1960) has analysed the food composition of 35 bigeye tunas (*Thunnus obesus*) and 91 yellowfin tunas (*Thunnus albacares*) caught in the eastern Indian Ocean during the 1956–1957 period. Kornilova (1981) studied the detailed food composition of yellowfin tuna and of bigeye tuna in the equatorial Indian Ocean from 1969 to 1973, and she provided an advanced taxonomic identification of the prey. Other studies have analysed the main prey groups eaten by yellowfin tuna and skipjack tuna (*Katsuwonus pelamis*) in the Seychelles and in the Mozambique area (Roger, 1994), and around India (Maldeniya, 1996). Potier et al. (2004) investigated the feeding partitioning among yellowfin and bigeye tunas in the western Indian Ocean using preliminary data from longline and purse seine caught fish. Potier et al. (2007) also investigated the resource partitioning among three large pelagic fish predators, yellowfin tuna, swordfish (*Xiphias gladius*) and lancetfish (*Alepisaurus ferox*) in the Seychelles area. These previous studies have investigated the diet of large pelagics offshore from purse seiners and longliners in the WIO region.

The study was meant to collect length data of the sailfish caught for comparison with previous data collected since 1987 which only concentrated on weight data. The second aim was to study the feeding behavior of sailfish among the coastal waters of the northern Kenya banks where the concentration of recreational fishing activities occurs highly. By considering large pelagic predators to be efficient biological samplers for collecting information on micronektonic organisms, due to their opportunistic feeding behavior, the study will derive information on the micronekton fauna of this area that is poorly documented. These data are essential not only for estimating the feeding strategy of the large pelagics in this region, but also for establishing new methods for the sustainable exploitation of this important fisheries resource based on ecosystemic information, which is recognized worldwide as an important management approach for future fisheries (World Summit on Sustainable Development 2002, Garcia & Zerbi 2003).

Objectives

The general objective of this study was to study the morphometrics and feeding habits of sailfish off the coast of Kenya to get an insight into their role in the ecosystem.

Specific objectives

1. To measure the morphometrics of the sailfish in northern Kenya banks caught by sports fishing vessels
2. To identify the composition of the micronekton in the area based on stomach content of the predators.

Justification and significance

Previous studies have investigated the diet of large pelagics offshore from purse seiners and longliners in the WIO but information is lacking in the inshore waters. The diets of sailfish are characterized by a great diversity of prey species (e.g. Sund et al., 1981), and predation by these pelagic predators is often described as an opportunistic process constrained by local prey availability. By using top predators as biological samplers of the micronekton organisms, the prey composition of the stomach contents provides unique information on the diversity of the forage fauna of this poorly known ecosystem. The study is meant to increase the knowledge in this poorly studied area with the intention of providing data which is vital for the implementation of an ecosystem approach to fisheries management of this area.

Materials and Method

Study Area

The study was undertaken in the Malindi area of the Kenyan coastline as indicated in the map below. Malindi area is on the northern part of the Kenyan coastline and has the highest concentration of the sports fishing activities due to availability of sea mounts and the proximity to the Somali current upwelling zone (Figure 1)

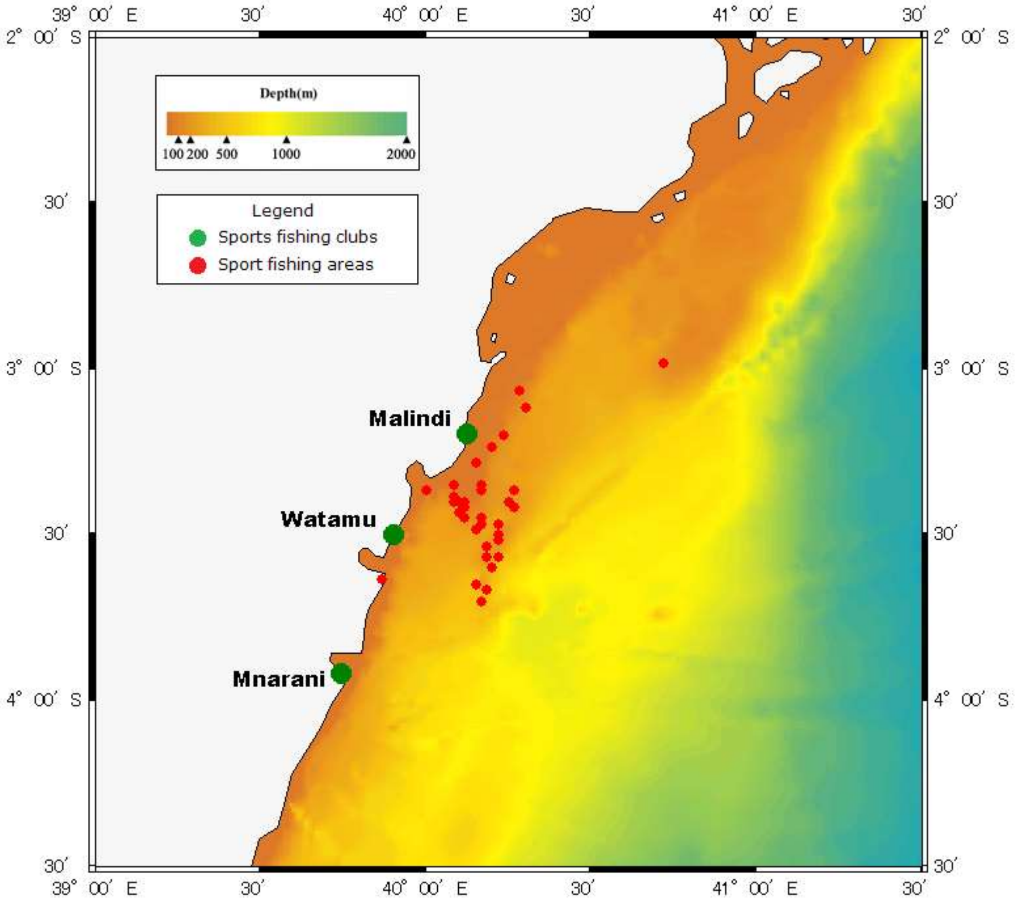

Figure 1: Fishing grounds used by the sports fishers

A normal day's expedition for a fishing boat takes about eight to ten hours. The boats leave at 6:00 AM and return at about 4:00 PM. The boats that fish near the coastline usually take a shorter period than those that fish further in the deeper waters. While on board the vessel, a gps was switched on throughout the trip to capture the positions where the boat traversed during the expedition and also take the points where a positive catch was recorded.

Figure 2: An active log of a boat trip during the data collection

Data collection

For the past over 20 years, sports fishing clubs have been collecting individual weights of sailfish caught but did not record the lengths. The study opted to collect more morphometric data to be used to validate previous datasets so as to make them relevant for future studies of the sailfish caught in the coastal waters in Kenya. For any predator population, some degree of variation in diet might be expected in relation to sex, age, maturity, season, year and area. This sampling was expected to detail on the age, sex and area. The data was collected on board the vessel during fishing trips and also at the Watamu and Malindi landing sites between October 2012 and January 2013.

The data parameters collected for the two species are as below.

- Date and time
- Body wet weight
- Post-orbital fork length
- Sex (Where possible)
- Area fished

Stomachs contents

The stomachs were removed and fixed with 10% formaldehyde for further analysis in the laboratory. All fresh and minimally digested cephalopod and fish prey were identified to the lowest taxonomic level possible and wet weight recorded to calculate their proportions by wet mass in the diet. The contents were divided into broad prey classes (crustaceans, fishes, squids, others). Heavily digested cephalopod and fish prey items were counted based on the number of beaks and intact vertebral columns, respectively.

Photo 1:Stomach samples in laboratory awaiting analysis

Data analysis

The stomach content index (SCI) was calculated as:

SCI (%) = (wet wt of stomach contents including both fresh and digested items/BW excluding wet wt of stomach contents) × 100

Afterwards we calculated the proportion of each prey item among the total number of food items identified ***(N)***, the wet wt contribution of each food item to the total wet wt of the stomach contents ***(W)***, and the frequency of the occurrence ***(F)*** of each food item in the total number of stomachs to be examined. Using these 3 indices, an index of the relative importance (IRI; Pinkas et al. 1971) of each food item *i* was calculated using the equation:

$IRI_i = (N_i + W_i) \times F_i$

Results

Peak season

From the 19 years complete data, it is clear that the peak season for sailfish is between October and February. The March to September season when the sea is rough has a poor catch report and the figure below illustrates.

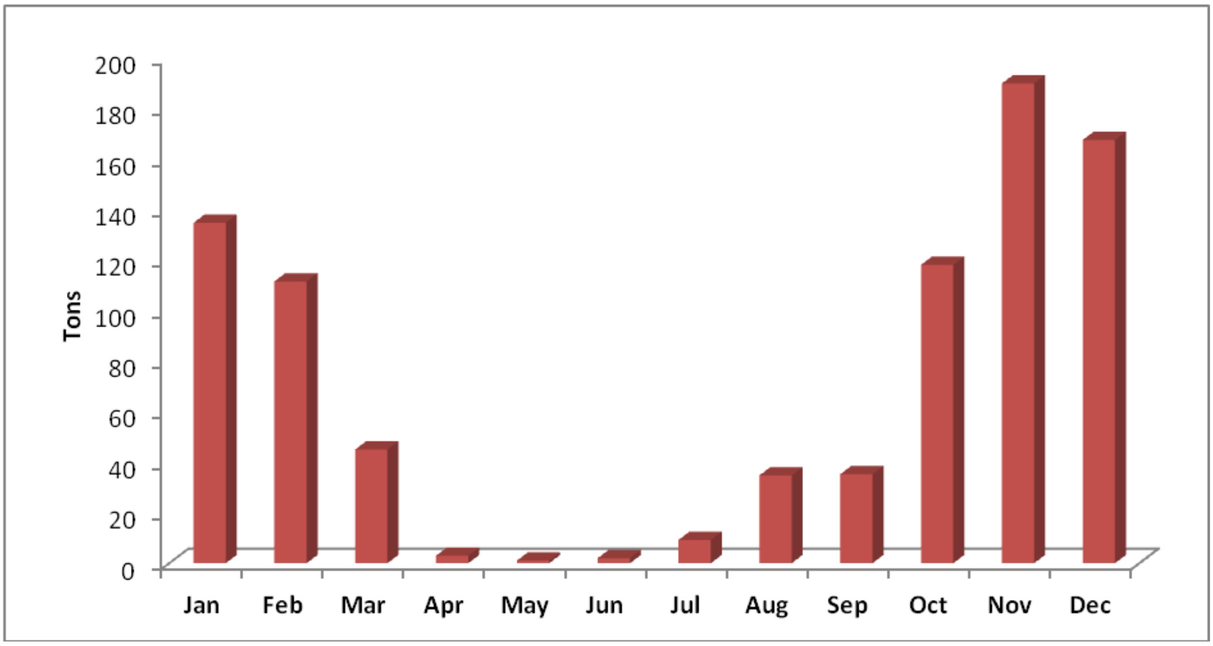

Figure 3: Total catches of sailfish by month

Catches by boats

For the 19 years period of sailfish catches, a total of 173 boats caught sailfish during their fishing expedition. From these boats most catches were dominated by five boats which between them caught 58% of the sailfish. 9 of the other boats caught 16% of the total catch with the rest 16% being attributed to all the other boats (Fig 4).

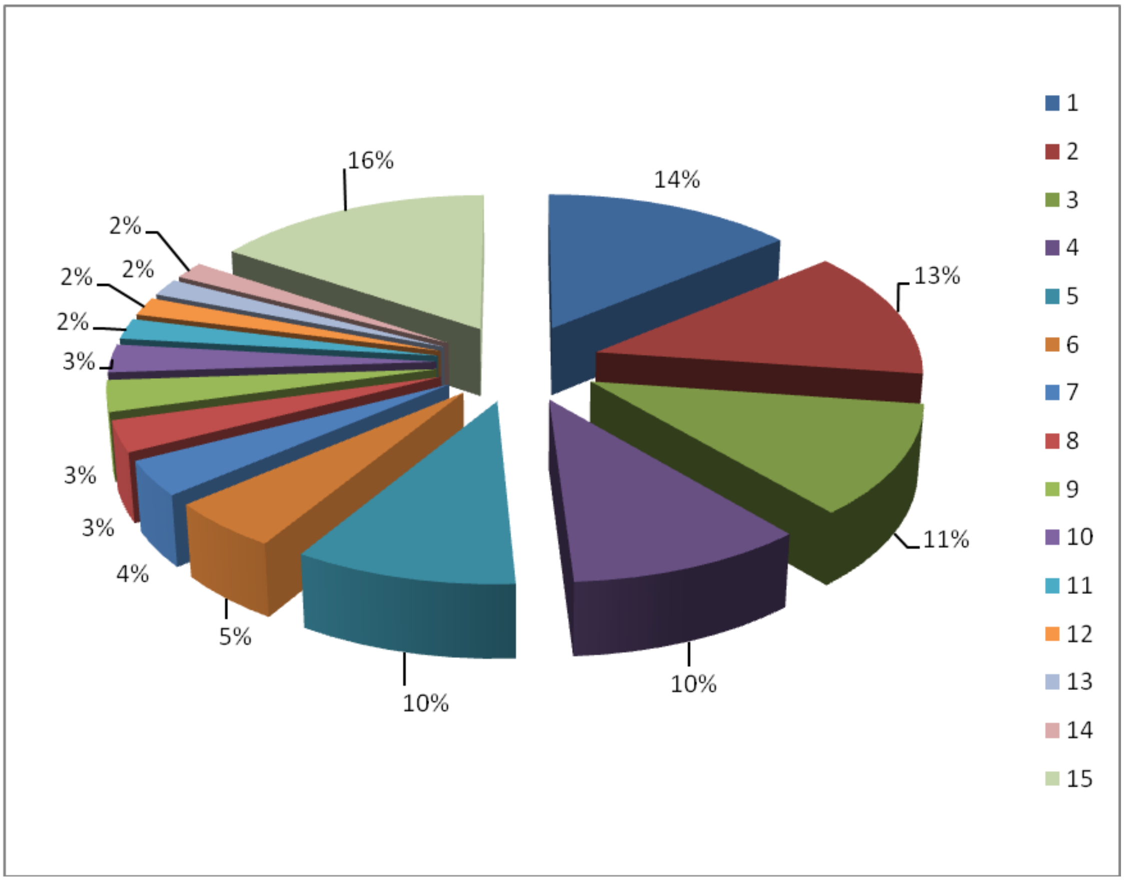

Figure 4: Total catches by boats

Mean Weight

For the 54 samples taken during the data collection the mean weight of the samples was 28.9 ±4.4 Kgs (range 20 – 39.5 Kgs). The mean weight was slightly higher than that for all the individuals caught for the past 19 years was 25.47 ± 4.59 Kgs (n=32232). The average catches of sailfish have been 44.9 tons per year (Fig. 5)

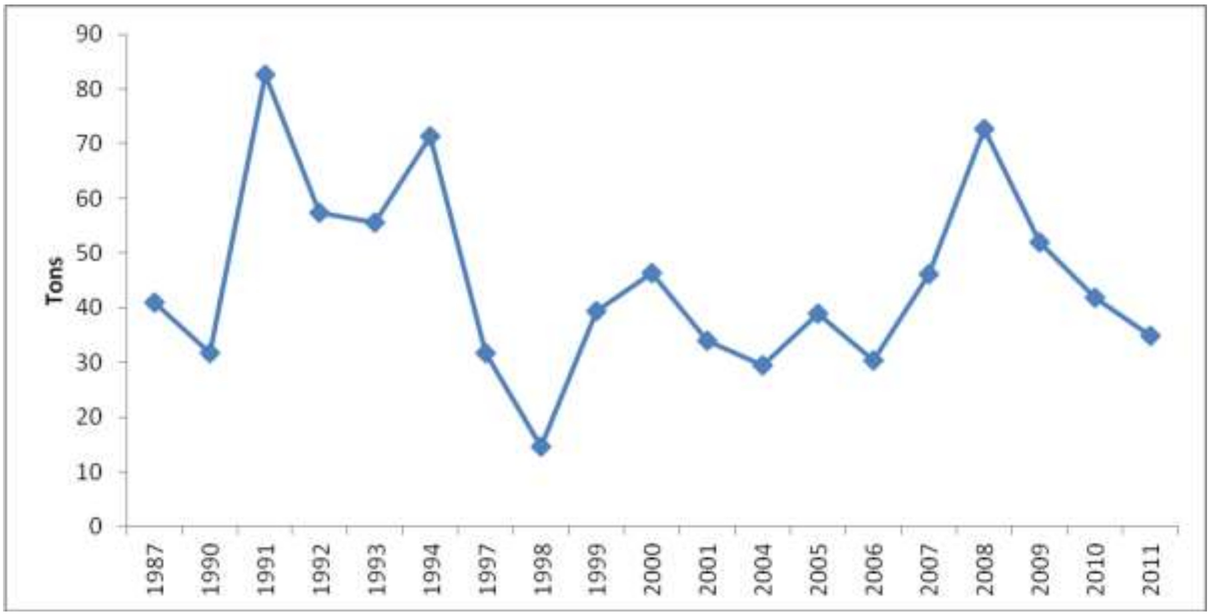

Figure 5: Total Malindi sailfish catches over the past 19 years

Length

The average post-orbital fork length for the sailfish was 166.5 ± 9.5 cm (range 140 – 184.6 cm). Most of the fish were in the 160 to 169 cm length class (Fig.6)

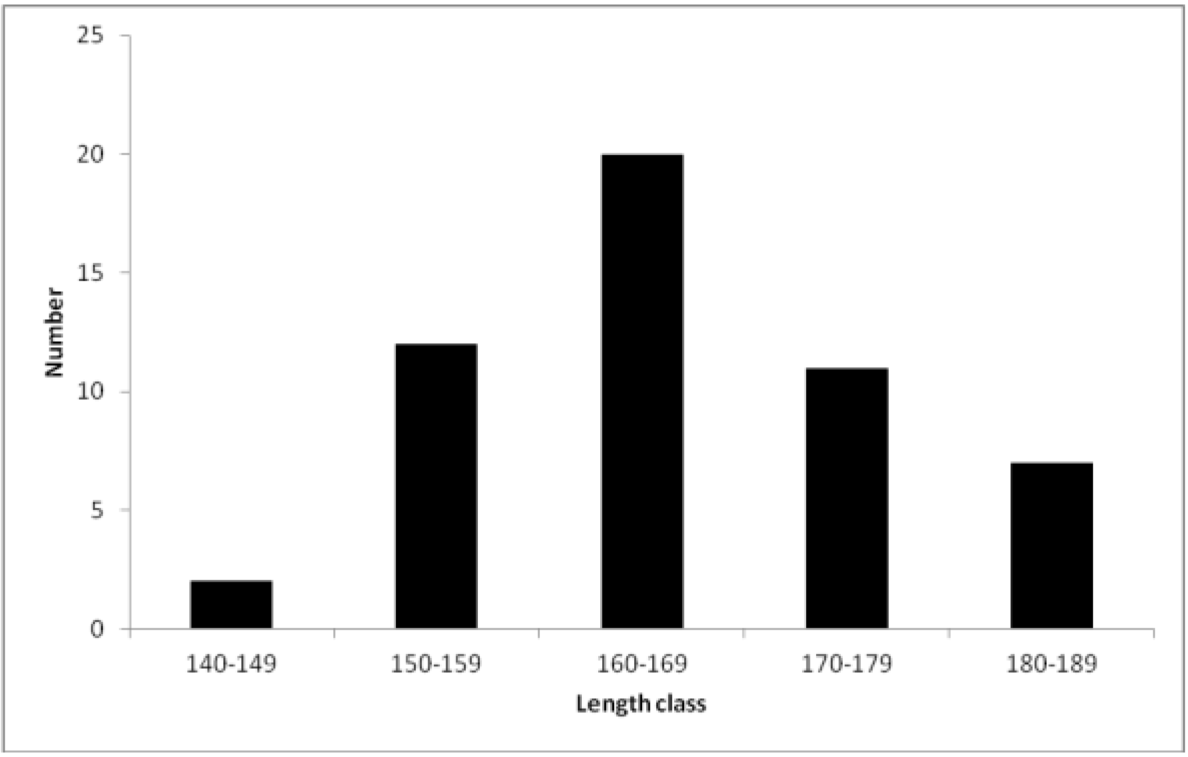

Figure 6: Length frequency distribution of the sailfish

Feeding

The crustacean *Charybdis smithii*,and fish *Stolephorus commersonii and Euthynus affinis* were found to be the most important food items consumed by sailfish (Table,1). The three composed of 94.2 of the IRI.

	N	N%	W	W%	O	O%	IRI	%IRI
Sepia Spp.	8	2	47	1	7	10	25	0.6
Charybdis smithii	161	34	1963	31	23	33	2142	48.7
Mantis shrimp	2	0	1	0	2	3	1	< 0.1
Larval crustacea	1	0	0	0	1	1	0	< 0.1
Stolephorus commersonii	252	54	673	11	12	17	1106	25.1
Arothron emaculatus	1	0	1.8	0	1	1	0	< 0.1
Euthynus affinis	15	3	3125.5	49	12	17	893	20.3
Unknown fish	26	6	577.3	9	11	16	229	5.2
Unknown	1	0	4.116	0	1	1	0	< 0.1

Table 1: Percentage Indices of food items of Sailfish

A total of 467 food items were counted in the 54 stomachs analysed. The most representative prey was *Stolephorus commersonii* (54%) *and Charybdis smithii* (34%). By weight, the most important prey were *Euthynus affinis* (49%), *Charybdis smithii* (31%) and *Stolephorus commersonii* (11%). The most frequent prey in the stomachs were *Charybdis smithii (33%), Stolephorus commersonii(17%) and Euthynus affinis(17%).* According to the percent of the Index of Relative Importance (IRI) only three food items represented more than 94% of the diet, with the most important *Charybdis smithii (*48.7%), *Stolephorus commersonii*(25.1%) *and Euthynus affinis*(20.3%) (Fig.7).

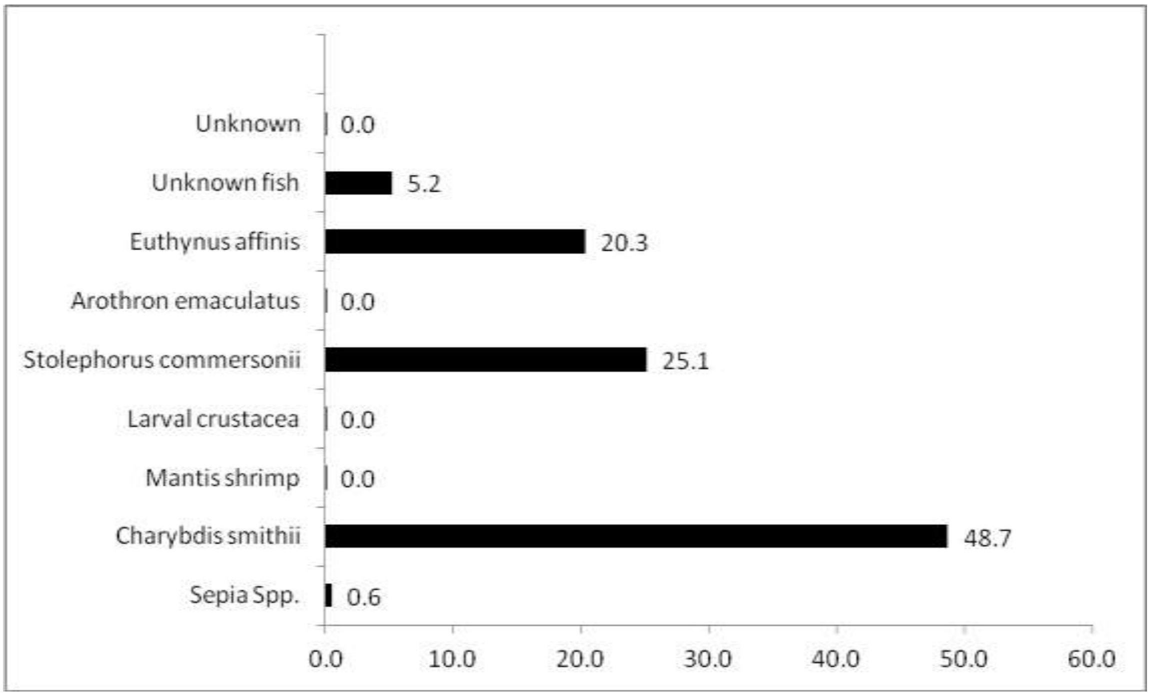

Figure 7: Most important prey of sailfish from Kenyan coastal waters. Percent of the Index of Relative Importance

Discussion

The peak season for sailfish in the Kenyan waters is October to February, which coincides with the North-East monsoon. The season also happens to be the busiest with many tourists visiting the country. Of the 173 boats that caught sailfish during the nineteen years recorded by the fishing club, 58% of the catch came from five boats. This shows that the boats were the most favoured by the sports fishers and could mainly be attributed to the experience of the boat crew.

The mean weight of sailfish caught during the study was similar to the mean weight over the 19 years duration. It is also similar to the mean weight of sailfish caught in Mexican waters (J. Rosas-Alayola et.al 2002). Most of the sailfish caught also happen to belong to the 160 – 169 cm length class. Over the years, the average catches of sailfish have been fluctuating with three peaks in 1991, 1994 and 2008. After the 2008 peak, there has been a steady decline from 73 tons to 35 tons. The lowest catches were previously experienced in 1998 but these could be associated to the heavy *el-nino* rains that led to lower fishing activities. Since the catch records of the sailfish have not been well documented in the region, this constant decline for the past three years may be a worrying trend for the species as this is the first time for the past 19 years to have a constant decline for three years.

A total of four prey items were identified to species level. The four items also happen to compose most of the food items consumed by the sailfish. This is in contrast with the 64 prey categories identified from sailfish in Mexican waters (J. Rosas-Alayola et.al 2002). The less food items in the stomachs could be an indicator of less prey in the coastal waters, or higher selectivity by sailfish when in the coastal waters. The major similarity between this study and the Mexican one is the dominance of particular prey in the stomachs of the sailfish. The major forage items for sailfish in Kenyan waters were crustaceans and fish with insignificant proportions of cephalopods. The study in Mexican waters also had fish as major prey items. The scombrids are a major food items of the sailfish in the study by Williams (1963) who also found the family scombridae (*Rastrelliger spp*.) as a major component of sailfish in 17 stomachs of sailfish from western Indian Ocean. The major difference in the results between the Kenyan coastal waters and Mexican waters studies relating to stomach content is the dominance of crustaceans here while the major component of the diet in the Mexican waters was the cephalopods.

The dominance of crustaceans in the diet of sailfish in the Kenyan waters is similar to other studies on pelagic fishes of the Western Indian Ocean region. Potier et al (2007), found *C. smithii* as a major food component of longnose lancetfish *Alepisaurus ferox* in a study near Seychelles shelf. This portunid crab was also found in large quantities in the stomachs of yellowfin tuna *Thunnus albacares* caught by longlines in the western Indian Ocean region (Zamorov et al.1992, Potier et al. 2007. The study shows that the diet of the sailfish when in the coastal waters and while in the open waters is similar. *C. smithii* seems to play a major role in the pelagic foodweb of the western Indian Ocean north western as it forms between 50% and 90% of the micronekton fauna in the upper 200m in the north-western Indian Ocean (van Couwelaar et. al, 1997).

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