Received: 19 June 2014

Comparison between Size Frequencies of the Narrow-barred Spanish mackerel Caught by Artisanal, Semi-industrial and Sport Linefishing in Southern Coast of Mozambique

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Abstract

The narrow-barred Spanish mackerel represent one of main commercial large pelagic fish harvested in the costal fisheries within the Mozambique EEZ. One of the main gear used to exploit this resource is hook and line (simple hand line gear and by Rod and reel), known as linefishing. This type of fishing is performed by all fishing sectors recognized in Mozambique, thus sub-categorized as artisanal linefishing, semi-industrial linefishing, industrial linefishing and Recreational linefishing. In the present study we analyzed the size frequency of narrow-barred Spanish mackerel harvested by these linefishing segments in southern coast of Mozambique. Size frequency distribution of narrow-barred Spanish mackerel harvested by semi-industrial, Industrial and sport linefishing has similar, with all landing large sized fish. It was found in these about 95% of landed fish ranging from 70 cm to 120 cm. Differently, artisanal linefishing showed impacts on both small size individuals and large size individuals with fishes with fork length less than 30 cm representing about 25% of total fish caught.

Key words: Narrow-barred Spanish mackerel, linefishing, size frequency.

1. Introduction

Marine ecosystems in Mozambique offer a variety of opportunities for harvesting of marine resources, ranging from industrial fishing with large vessels to shore-gathering by artisanal harvesters. One of the simplest but most effective gears to catch fish is by means of hook and line (simple hand line gear and by Rod and reel), known as linefishing. This fishing activity is undertaken by the four fishing sectors recognized in the country: artisanal, semi-industrial, industrial and recreational. All these linefishing modalities are costal fisheries with operations impacting on multi-species, ranging from costal resident demersal to pelagic migratory species. Based on results some studies of these linefishing segments it can be inferred that narrow-barred Spanish mackerel (*Scomberomorus commerson*) constitute the main IOTC pelagic species caught in common by these four linefishish segments (IIP 2012, IIP 2013, Fennessy *et. al.* 2012, Chioze 2014). According to the IOTC (IOTC–2013–SC16–R[E]) there is considerable uncertainty about stock structure and the total catches of the narrow-barred Spanish mackerel in the Indian Ocean. No quantitative stock assessment is currently available for narrow-barred Spanish mackerel for the entire Indian Ocean, and due to a lack of fishery data for several gears, including linefishing, the stock status of this species remains uncertain. In the specific case of Mozambique, there a gap of knowledge and understanding regarding the impact of all linefishing sectors on the stock of this species. Most of the data available and information documented is regarding the semi-industrial and industrial linefishing (IIP 2012, IIP 2013, Fennessy *et. al.* 2012). Assuming that artisanal and recreational fishing also harvest significant amount of this resource, it is important that fisheries research and management also take into considerations the impact these linefishing modalities on narrow-barred Spanish mackerel in order to understand better how the stocks of this species are and what the specific management measures can be applied for sustainability.

The present study aims to analyze the size structure of narrow-barred Spanish mackerel harvested by all these linefishing segments in Mozambique.

2. Characterization of the operations

Table 1 shows the characteristics of linefishery sectors and sub-sectors with potential impacts on Spanish mackerel stocks (based on: van der Elst *et al* 1995, van der Elst *et al* 2003, Lichucha 2001, Fennessy *et al* 2012). The gears have basically a monofilament line which takes a variable number of hooks at the terminal part. The hooks of variable sizes are baited with pieces of fish (Indian mackerel and other small fish) or squids. Each gear is operated manually by one fisher. The rod and line takes manual reels to recover the line.

Table 1. Summarized description of Mozambican linefishery sectors and sub-sectors with potential impacts on Spanish mackerel stocks.

Sector	Sub-sector	Vessel	Crew	Trip duration	Gear	Species and
Artisanal	paddle/sail	Boat 3-8m	2-3	1 day	Handline	Demersal + pelagic
	(motorized-outboard)	Boat 5-10m	3	1 day	Handline	Demersal + pelagic
	Skiboat	5-8m	3-6	1 day	Rod and line	Demersal + pelagic
Recreational	Skiboat – sport	5-8m	2-6	1 day	Rod and line	Pelagic catch only
Semi-industrial	Port-based	10-20m	10-15	7 -12 days	Rod and line/ handline	Iced catch Demersal + Pelagic
Industrial	Port-based	>20m	10-30	15 days	Rod and line /handline	Frozen catch; Demersal + Pelagic

Artisanal linefishing

A large number of people harvest linefish as part of small-scale fisheries. These operations are largely confined to the near-coastal zone, mostly boat-based and use either sail or engine power. For Artisanal linefishing there is no a specific targeting depending on local availability of the resources. On general, due the limitations in terms of capacity and autonomy of the boats the operations are confined to the inshore coastal areas, harvesting coastal resources mainly within the 3 nautical miles. Increasingly, new technology is entering this sector. The artisanal catch is important for local and district food security which are primarily traded on proximal markets.

Most artisanal fishers are formally licensed. Although this sector is of local economic significance, few artisanal fishers are part of the formal economy.

Semi-industrial and Industrial linefishing

The operations are boat based, often with sizeable crew and extensive sea going capacity and facilities (Table 1). Legally semi-Industrial sector is defined as being motorized vessels and 10 to 20 m in length, while Industrial sector vessels comprises vessels with length over 20m. All are formally licensed and the vessels operate from one of several harbors. The range of operations is considerable, enabling this sector to move in response to fishing trends and seasonality. The semi-industrial and industrial linefishing is generally oriented to harvest demersal fishes (although the pelagic component is also taken) and operates over reefs or rocky bottom areas from 20 to 200m depth.

Recreational linefishing

A second sector, which is more formally organized, is the sport or gamefish sector. These fishers belong to a club that normally sets standards for fisher ethics, organizes tournaments and may contribute to conservation initiatives. Most fish from sea going craft that make daily trips from a port base. This sector prefers to target pelagic or gamefish species such as those from the Scombridae, Carangidae and Istiophoridae.

3. Methodology

3.1. Study Area

The data used for this study were collected in southern coast of Mozambique (26°S-21°S), within the continental shelf area (Figure 1). Artisanal linefishing data from Spanish mackerel were obtained from catches of costal inshore areas mainly within the 3 nautical miles in bathymetric depths less than 50m along the Inhambane Province (24°S 50’ - 21°S 30’). Semi-industrial and industrial are only aloud to fish above the 3 nautical miles. These large vessels operate mainly in areas where the substrate is predominantly hard (reef) in bathymetric depths between 25 to 200 m (Figure 1). Sport fishers overlaps both artisanal and semi-industrial areas but normally at bathimetric depths less than 100m. For fishing competitions, data used in this study were at Inhaca (A) , Tofo (B) and Inhassoro (C) (Figure 1).

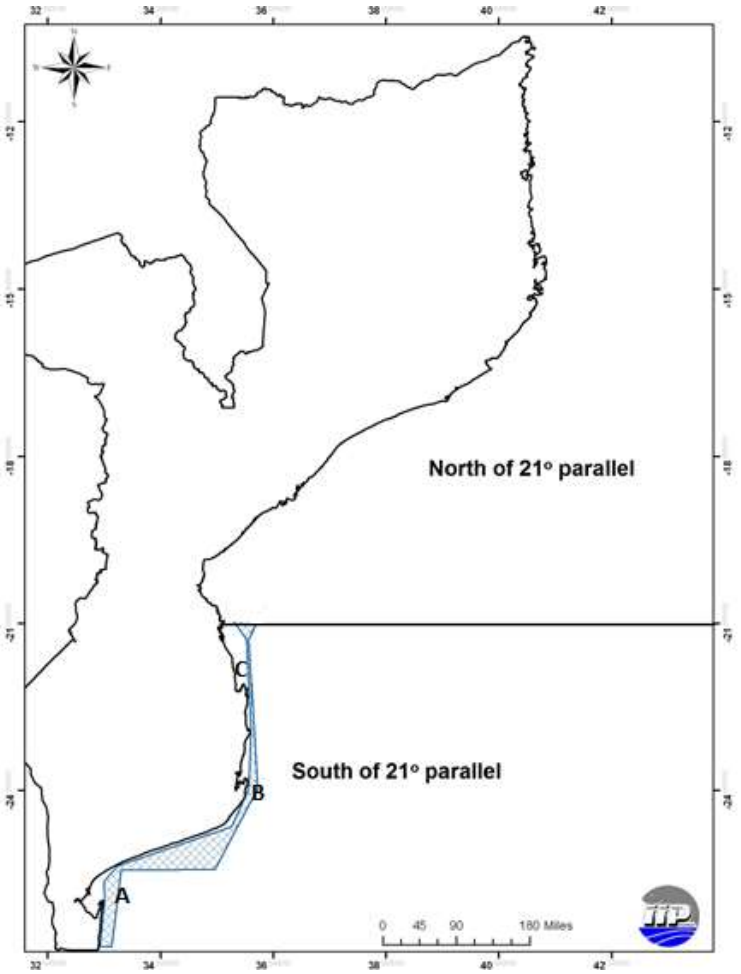

Figure 1. Linefishing operation area in southern coast of Mozambique. Semi-industrial and Industrial (blue area). Sport fishing (A= Inhaca, B = Tofo and C= Inhassoro).

3.2. Data collection

All data used here were collected by IIP (Fisheries Research Institute) throughout random sampling systems.

Artisanal linefishing data

Monitoring of artisanal fisheries is made by sampling on landing site; not all fisheries centers are monitored, but there is considerable coverage in general. Biological data from the artisanal sector are only available the main species that support the fisheries in terms of production including sand and reef associated demersal fishes like tigertooth croaker (scianidae), Javelin Grun (Heamulidae), emperors (Lethrinidae) and some small pelagic species. The only large pelagic which is monitored (but not regularly and not in all locations) is the narrow-barred Spanish mackerel.

Semi-industrial linefishing data

Regular sampling on-board semi-industrial and industrial vessels is undertaken by IIP observers with an intended of one sampling trip undertaken per month on which the observer records among other data; the species composition and lengths of the main rock bottom associated demersal specie and also of the main pelagic species which is Spanish mackerel. For collection of length data on board of the vessel, a sample is randomly taken and each fish is measured both fork and total lengths using a measuring board with an accuracy of 0.5 cm.

Sport linefishing data

For the sport fishing data collection commenced in 2005, with IIP recording catches weighed in during pelagic fishing competitions in Maputo, Inhambane. Not all competitions are attended by IIP. All weighed-in fish are sampled, providing species composition, length and other relevant data.

Data from Sport fishing used here were collected in a total of five fishing tournaments; three competitions in Maputo province (at Inhaca) and two competitions in Inhambane province (Inhassoro and Tofo). Data from Maputo were collected in 2008 and 2009, while data from Inhambane were collected in 2011 and 2012. A total of 252 individual fish Spanish mackerel were measured in these competitions.

3.3. Data analysis

The size structure was analyzed by plotting the histogram of distributions of the fork lengths for both sexes combined based on aggregate data obtained for each fishing sector (artisanal, semi-industrial and industrial together and sport fishing). The frequencies used here were relative frequencies of the total number fish sampled. The histograms were plotted by using the statistical software Prima 6.0.

4. Results

Size frequency of narrow-barred spanish mackerel harvested by artisanal boats shows two distinct modal classes; one of small fishes with fork length less than 30 cm and other of medium to large size individuals with fork length ranging from 60 to 150 cm (Figure 1). Small fishes less than 30 cm represented about 25% of total fish harvested while large fishes ranging mainly from 70 to 110 cm represented 64% of total fish.

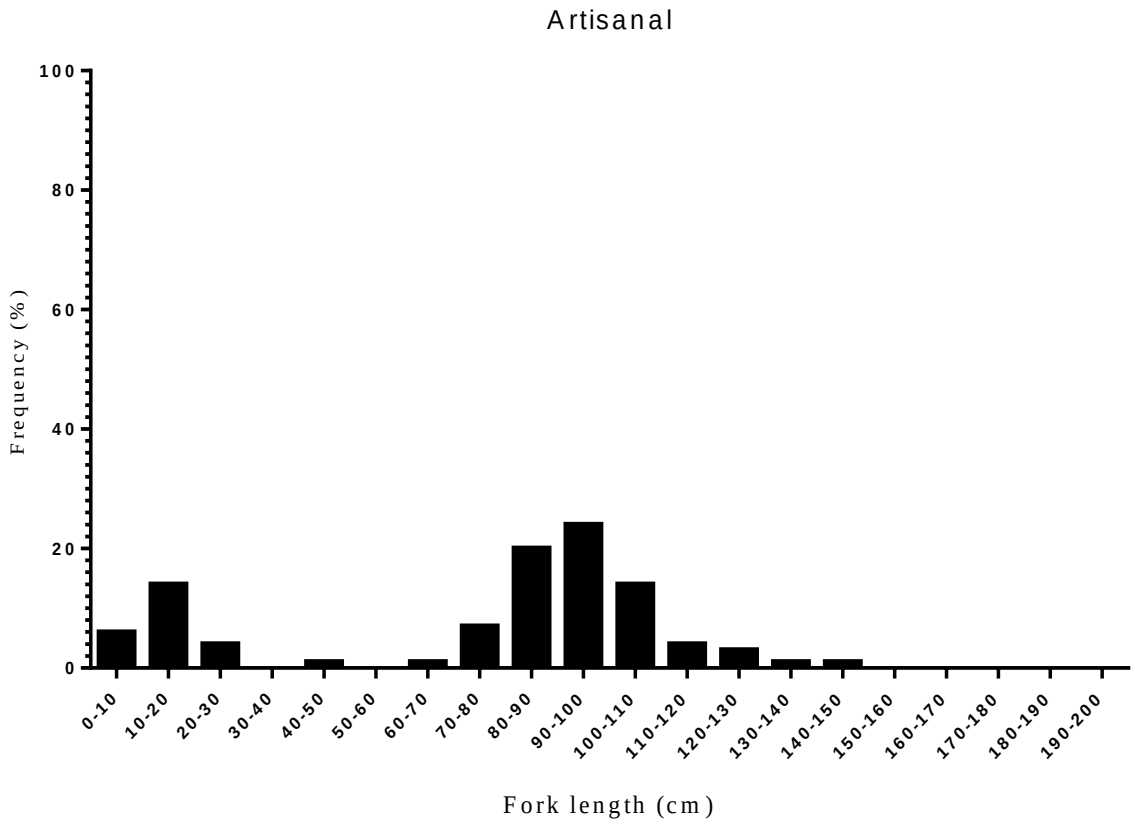

Figure 2. Length distribution of narrow-barred Spanish mackerel harvested by artisanal linefishing in the southern coast of Mozambique (2009-2013/ Inhambane province). N= 276 individuals.

For semi-industrial and industrial linefishing, it can be seen practically one modal length distribution for narrow-barred Spanish mackerel harvested, with the majority of the fish (95%) ranging from 70 cm to 120 cm fork length.

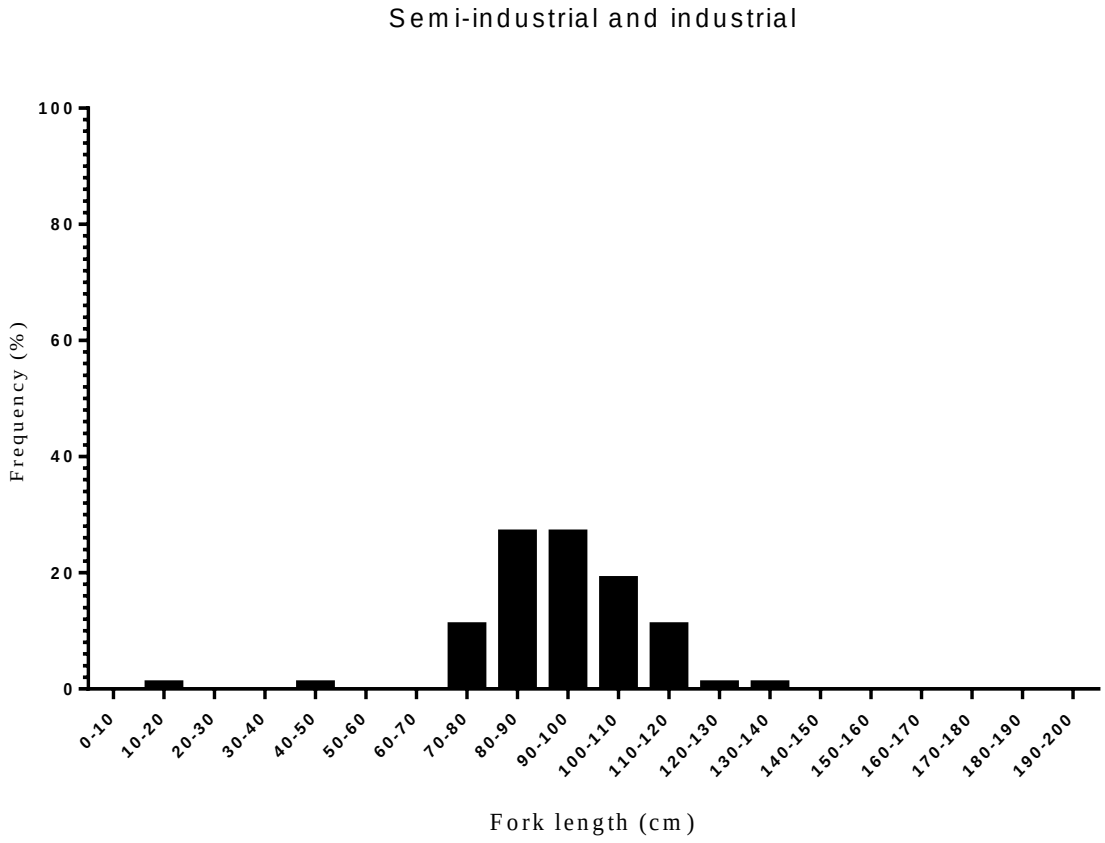

Figure 3. Length distribution of narrow-barred Spanish mackerel harvested by semi-industrial and industrial linefishing in southern coast of Mozambique (2009-2013). N=962 individuals.

The sizes of narrow-barred Spanish mackerel landed during fishing competitions showed one clear modal distribution with fish ranging from 50 to 130 cm. It has found about 94% of fish landed ranging from 70 cm to 120 cm.

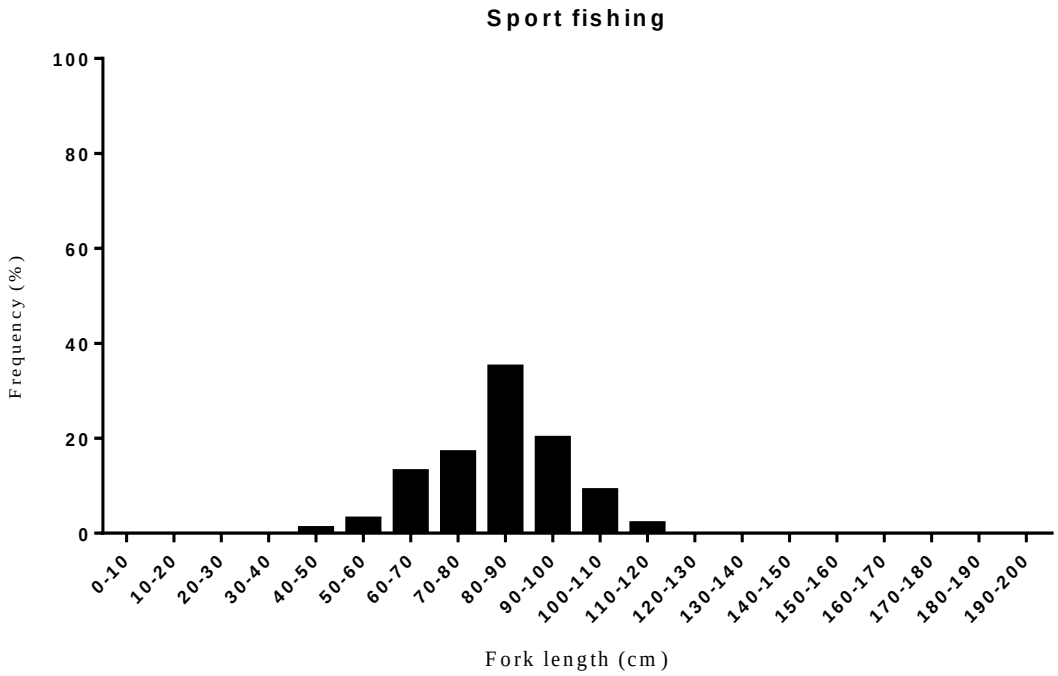

Figure 4. Length distribution of narrow-barred Spanish mackerel harvested during some fishing competitions in southern coast of Mozambique (Inhassoro, Tofo and Inhaca). N=252 individuals.

5. Discussion

The size distribution of Spanish mackerel harvested by large commercial vessels and those landed by recreational boats during fishing tournaments were similar. Both linefishing sectors showed preference to large size adult fish with the main landed fish ranging from 70 cm to 120 cm fork length. The similarity between size distribution of narrow-barred Spanish mackerel harvested by semi-industrial/industrial and sport fishing was equally demonstrated by Fennessy *et al*. 2012 based on data collected from 2005 to 2010 in these linefishing modalities in southern Mozambique. These findings are associated with the size selectivity of these linefishing sectors. The semi-industrial and industrial linefishing have preference for same species and sizes. They target mainly on demersal reef species and thus fishing operation involve active maintenance of

the boat aver the reef by the skipper. During the night the vessel moves to inshore areas where it remains anchored until the sun rise. While anchored in order to increase the production the fishery target on large pelagic Spanish mackerel. Also when the catches of demersal species are not good the fisheries find on Spanish mackerel a source to increase the volume of production. The sport fishery is a size (weight) oriented pelagic fishery. They target on large game fish as per tournament rules. Fishes with non-desirable sizes when caught are realised alive in many cases.

Differently from the linefishing modalities mentioned above, this study showed that artisanal linefishing impacts on both small size individuals and large size individuals. The small size fish component found in the catches of this sector is probably associated with the inshore areas where a significant part of operations of this fishery takes place, which constitute nursery for juveniles of many species (Chioze 2014). These areas include coral reef, seagrass bads, and other coastal inshore habitats (Chioza 2014). This, also may be associated with the small size of the hooks employed by this segment. Another possible explanation for this potential harvesting of juveniles is the use of multi-gears including gillnets by the artisanal linefishers. All catches can be declared as linefishing product while in fact other gears were used during the fishing operations.

6. Conclusions

- Narrow-barred Spanish mackerel is the one of main large pelagic species exploited in common by artisanal, semi-industrial, industrial and sport hook and line fishery in southern coast of Mozambique.

- There is no differences between the size distribution of narrow-barred Spanish mackerel harvested by large commercial vessel and those recreational boats during fishing tournaments. Both showed preference to large size adult fish. The majority of fish landed by these linefishing segments range from 70-120 m fork length.

- Artisanal linefishing impact on both small size individuals and large size individuals. Fishes less than 30 cm represented about 25% of the catch.

7. Recommendations

- Intensify the sampling of biological data of narrow-barred Spanish mackerel in all linefishing segments including the recreational fishing out of the tournaments (tourism linefising).

- Collect biological data also of other important neritic IOTC species in all fishing sectors, mainly in the artisanal sector which actually there is no biological sampling of large pelagic species apart from narrow-barred Spanish mackerel.

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