Industrial longlining catch rates, temporal variation and length-frequency of swordfish (Xiphias gladius) fishery in the Kenyan Marine waters

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Abstract

Swordfishes (Xiphias gladius) are important pelagic fish species found in tropical waters. The species are majorly caught by industrial longlines, the nominal catches of Swordfishes in the years 2019, 2020, 2021 and 2022 were 214MT, 16MT, 252MT and 261MT respectively. The species was encountered throughout the year with clear evidence of temporal variation in catch rates. Pooled data indicate industrial longline has an average catch rate of 1.2MT/1000hooks/Trip. The pooled data also indicates that average catch rates for swordfish were high between the months of May and November 2022 while the Low catches were recorded on the average between the months of February, April, and December 2022. The minimum and maximum fork length of the swordfish encountered in the sample were 59cm and 245 JFL cm respectively, whilst the average length was 124.5cm. Most of the species captured were within the size range of 77.5 cm-162.5 cm and Five length classes are evident from this analysis between 107.5cm to 132.5cm. The analysis indicates seasonality partly influenced the catch rates of swordfish in the Kenyan coastal waters. This temporal distribution of the swordfish catches and abundance could be partly attributed to the seasonal changes in the temperature of the sea water and availability of food in the environment. While length classes could be attributed to the different size and depth of hooks as well as length of set lines, and the specific size of individual fish targeted

1. Introduction

Swordfish (Xiphias gladius) is a highly migratory species that forms an important fishery globally including Kenya. In the Indian Ocean the fishery is usually targeted by both artisanal and industrial long line fishers (IOTC, 2019; and Mueni et al., 2019). The species is distributed within the range of 65° N - 50° S to 180° E according to Fishbase (2019). Swordfish is found in deep oceanic waters though on some occasions it is found in coastal waters (Mueni et al., 2019; and Varghese et al., 2013). During the year 2022, Kenya landed 527 MT of assorted fish, with swordfishes accounting for 46.5 % (261 MT) of the total longline industrial catches. This represents 1.1% of total Indian ocean swordfishes catch of 23,917 MT (IOTC, 2022). While previously in 2019, 2020, and 2021, 214MT, 16MT and 252MT respectively of Swordfish were landed by longlining industrial vessels in Kenya, (Ministry of Agriculture, Livestock and Fisheries, 2021). The longline fishery in Kenya mostly occurs beyond 12 nautical miles, within the 200 nautical miles in the Kenya's Exclusive Economic Zone (EEZ) and the high seas. In 2022, four (4) industrial longline vessels were active in the Kenya EEZ. The fishing effort was based on number of days fished, the number of hooks deployed, average length of setline and hours fished per set.

In this paper, we investigate the temporal variation in fish catch rates, length frequency distribution for the swordfish (Xiphias gladius) fishery in Kenya coastal waters. The findings of this study contribute to the scientific knowledge of the Swordfish fishery in Kenyan waters that will provide support to policy sustainability for increased socio-economic benefits to the local fishing communities and the national economy

2. Materials and methods

2.1. Study areas

The investigation is based on observer data reported from industrial longlines in Kenyan marine waters beyond 12 nautical miles, within the 200 nautical miles in the Kenya's Exclusive Economic Zone (EEZ) and the high seas.

2.2. Sampling and collection of data

The study was conducted between the months of February 2022 and December 2022. Fish samples were during the period, catches landed by industrial vessels using mainly longline. The vessel was the Primary Sampling Unit, the fishing trip was the secondary

sampling unit and the swordfish catch was the tertiary sampling unit. The fish samples were identified to the species level using identification guide by Smith and Heemstra (1995), Richmond (Eds.) (1997) and Anam and Mostarda (2012). Fish samples were weighed to the nearest Kilogram (Kg) using a weighing scale, The total length (TL) and the Lower Jaw Fork Length (LJFL) of the individual fish were measured to the nearest whole centimeter (cm) using a measuring tape. The number of hooks deployed, shallowest and deepest depth of hooks, length of set lines, starting mid-day and ending date and position of fishing vessel were recorded in a data collection form for tuna and tuna-like species based on the IOTC template. The data was entered in an excel spreadsheet, cleaned and organized before it was analyzed.

3. Data Analyses

3.1. Catch Per Unit Effort (CPUE)

The Mean Catch per Unit Effort (CPUE) was calculated by computing average catch per 1000 hooks per fishing trip as shown below. CPUE = Cy /Ey Where Cy is Catch at time y, E is the fishing effort that was deployed at time y.

3.2. Length-Frequency Distribution

The data from the different sites and vessels was pooled and binned in 5 cm intervals. The length - frequency distribution data was used to prepare graphs and catch curves.

4. Results and Discussion

4.1. Temporal variations of swordfish catch rates

Swordfish was encountered throughout the sampling period with clear evidence of temporal variation in catch rates (Figure 2). Highest Catch rate of 1.9MT/1000hooks/Trip was reported in the month of July 2022. This was closely followed by May 2022 with catch rate of 1.6MT/1000hooks/Trip. Pooled data indicate that the average catch rate of swordfish was high between the months of May and November 2022. Low catches on the average were recorded in the months of February, April, and December. The results

indicate that seasonality influenced the catch rates of Swordfish in the Kenyan coastal waters (Figure 2)

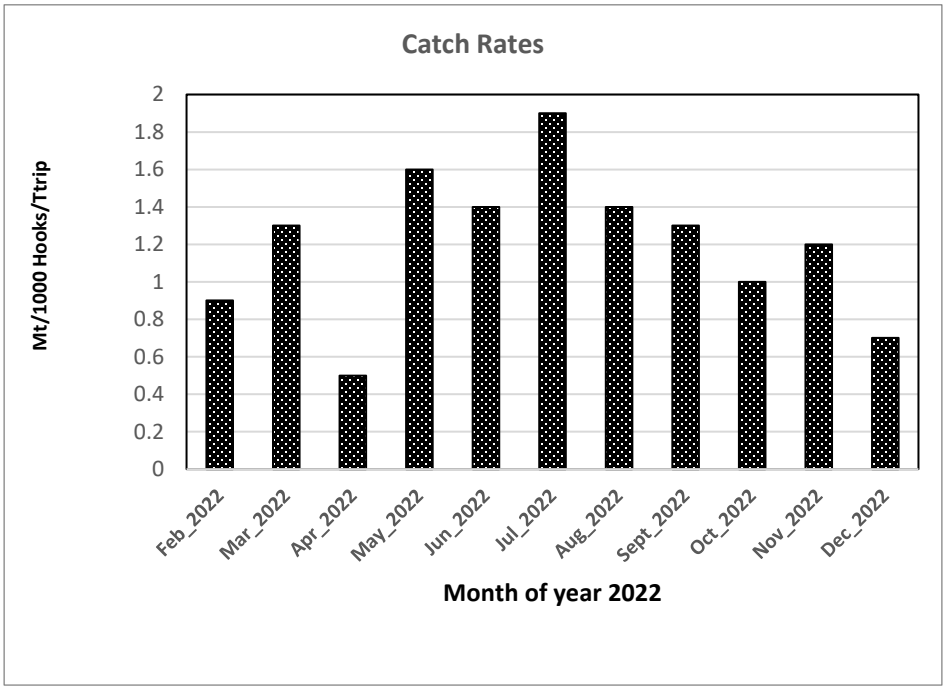

Figure 2: Monthly variation of Swordfish mean catch rates (MT/ 1000 hooks/trip) from the waters of Kenya for the period February 2022-December 2022

The results indicate that seasonality partly influenced the catch rates of swordfish in the Kenyan coastal waters. This temporal distribution of the swordfish catches and abundance could be partly attributed to the seasonal changes in the temperature of the sea water, and availability of food in the environment (Mueni et al., 2019; Lan et al., 2014; and Ward and Elscot, 2000).

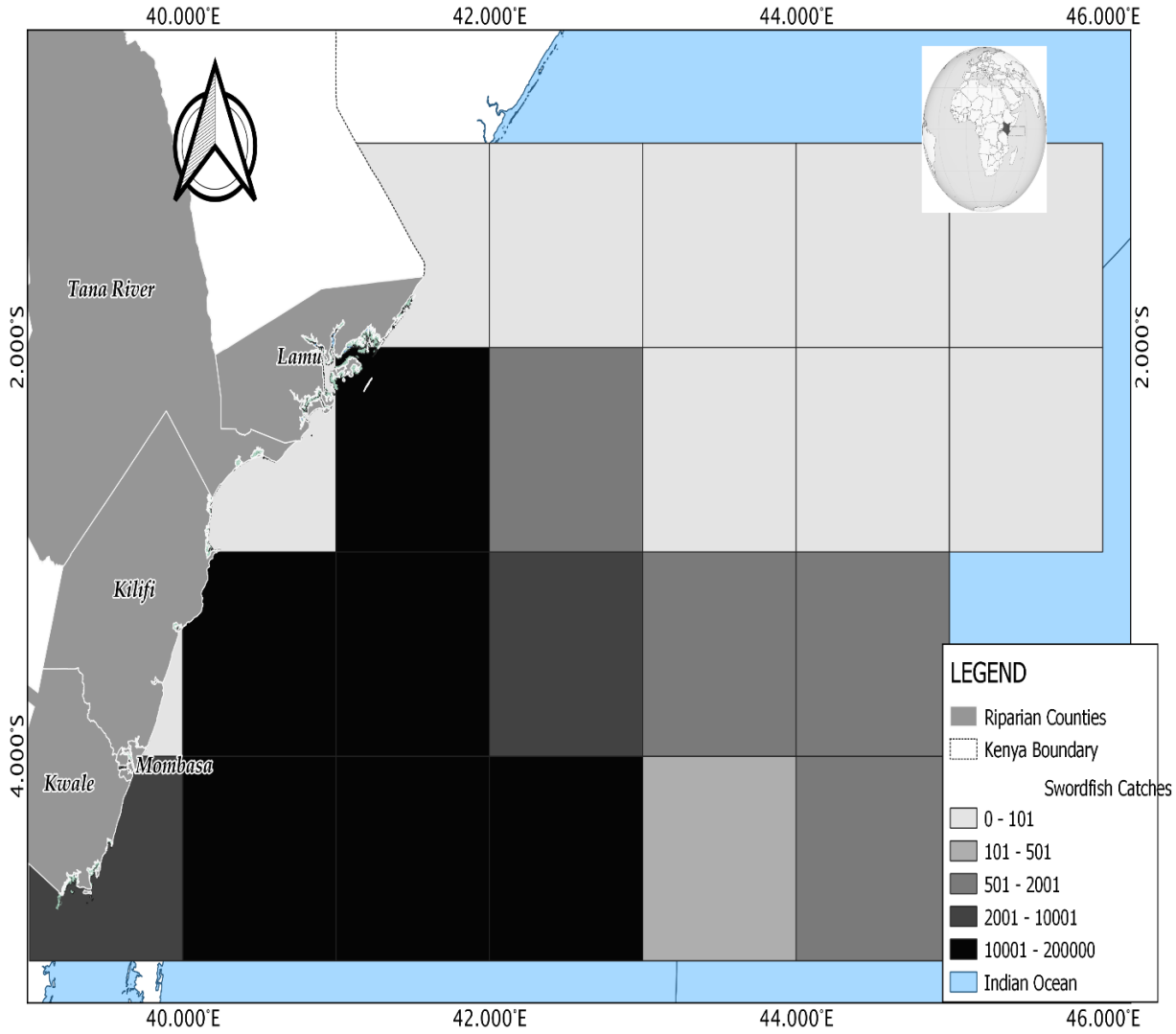

Figure 3. Map showing grids (1º) of fishing areas and fishing intensity for long liners in the waters of Kenya for the period between February 2022-December 2022

Comprehensive information on distribution and seasonal abundance of the swordfish fishery is important for sustainable conservation and management of the fishery. More effort should be directed to a comprehensive investigation on the stock structure and distribution of the swordfish fishery in Kenya and indeed the entire Indian Ocean region.

4.2. Length-Frequency Distribution

Length-frequency analysis for the 1136 individuals' show that the swordfish sampled were of various sizes ranging between 59cm and 245 JFL cm respectively (Figure 3), with an average length of 124.5cm. Most of the individuals captured were within the size range of 77.5 cm-162.5 cm, while the modal length range was 117.5 cm-122.5 cm. Five length classes are evident from this analysis between 107.5cm to 132.5cm. These length classes could be attributed to the different size and depth of hooks as well as length of set lines, and the specific size of individual fish targeted. Trend in the size changes should be examined closely over time to provide an indication of swordfish status. Maturity status and stock structure of the swordfish fishery should guide in setting Minimum Landing Size (MLS) of the swordfish as part of the technical measures to ensure the sustainability of the stocks

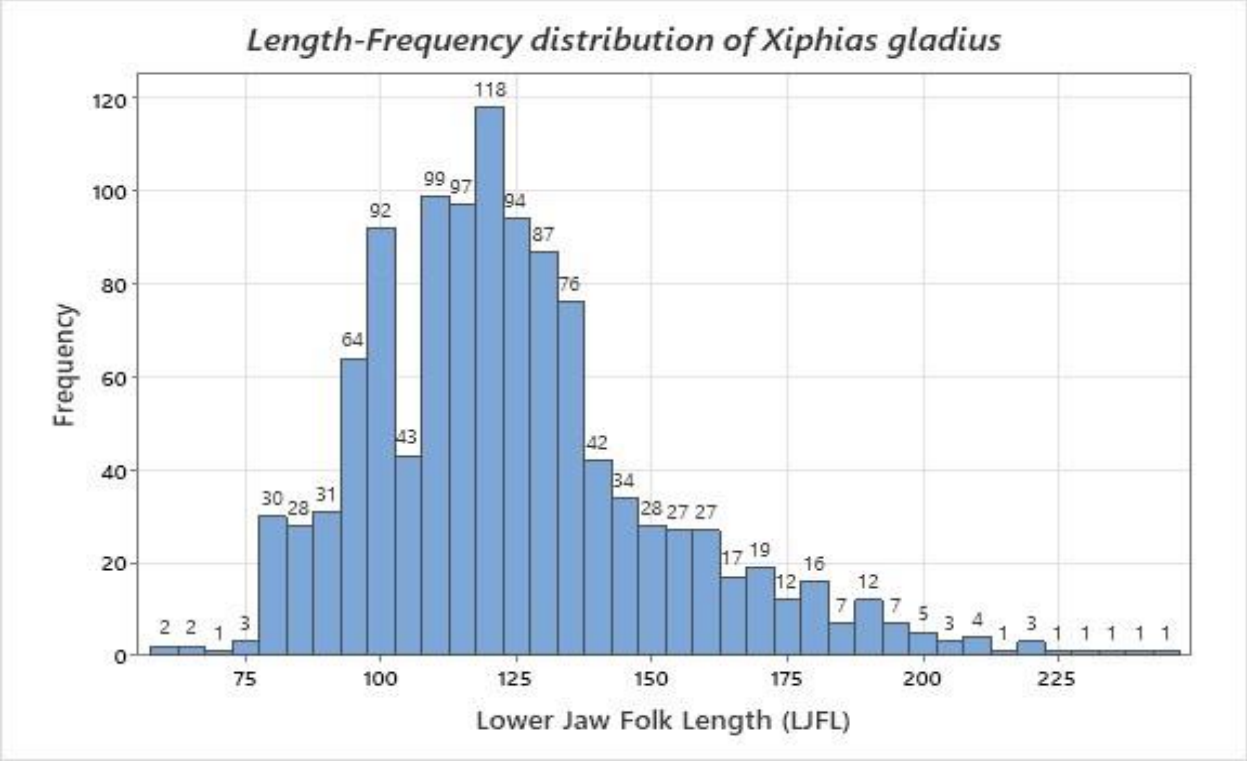

Figure 3: Length-frequency distribution for Xiphias gladius sampled in the coastal waters of Kenya between February 2022 and December 2022

5. Conclusion

The findings of this study indicate that different sizes of swordfish were landed by industrial longlines throughout the sampling period. However, temporal variations in the catches were evident as high catch rates were reported between May and November. Precautionary approach should be applied in the management of the swordfish fishery in the nearshore waters as more genetic and maturity studies are undertaken to ascertain whether the individuals less than 99 cm FL are mature and contribute to the recruitment of the swordfish stock (Kimakwa et.al., 2022). Development and introduction of technical measures and appropriate regulations defining Minimum Landing Size (MLS) for the swordfish fishery in Kenya coastal waters is a worthy consideration by the fisheries management authorities at national and regional level. This would enhance the sustainability of the swordfish stocks and reduce the capture of young individuals.

6. References

Anam, R. and Mostarda, E. (2012). Field identification guide to the living marine resources of Kenya. FAO species identification guide for fishery purposes. FAO, Rome.

Edward Kimakwa, Micheni Ntiba and Agnes Muthumbi (2022). Temporal variation, population and growth parameters of swordfish (Xiphias gladius Linnaeus, 1758) in the nearshore waters of Kenya. African Journal of Biological Sciences. 4(1), 67-81. doi: 10.33472/AFJBS.4.1.2022.67-81.

Fishbase (2019). Xiphias gladius Linnaeus, 1758 Swordfish. Retrieved at https://www.fishbase.in/summary/ 226

IOTC. (2022). Executive Summary: Swordfish (2022). Retrieved at https://iotc.org/science/status-summaryspecies-tuna-and-tuna-species-under-iotc-mandate-well-other-species-impacted-iotc

Lan, K., Lee, M., Wang, S. and Chen, Z. (2014). Environmental variations on swordfish (xiphias gladius) catch rates in the Indian Ocean. Fisheries Research, 166, 67-79.

Ministry of Agriculture, Livestock and Fisheries. (2016). Fisheries Annual Statistical bulletin. State Department of Fisheries and Blue Economy, 65p.

Mueni, E., Ndegwa, S., Wambiji, N., Okemwa, G. and Kadagi, N. (2019). Kenya National Report to the Scientific Committee of the Indian Ocean Tuna Commission, 2019. IOTC-2019-SC22-NR_Rev1.

Richmond, D.M. (eds). (1997). A guide to the seashore of Eastern Africa. SIDA, Department of Research and Cooperation.

Smith, M. and Heemstra, P. (1995). Smiths's sea fishes. Southern Book Publishers. New York. USA.

Varghese et al. / Turk. J. Fish. Aquat. Sci., 13, 529-540 (2013) swordfish, Xiphias gladius Linneaus, from the Mediterranean Sea. Journal of Experimental Marine Biology and Ecology, 188, 79-88.