UNITED NATIONS UNIVERSITY
Fisheries Training Programme

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Final Project 2011

CATCH AND CPUE TRENDS IN THE ARTISANAL LINE FISHERY IN MAPUTO BAY, MOZAMBIQUE IN THE YEAR 1999-2010, AND ANALYSIS OF THE TWO MAIN SPECIES; SADDLE GRUNT (POMADASYS MACULATUM) AND SILVER SILLAGO (SILLAGO SIHAMA)

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ABSTRACT

In this study the objective was to look at trends in catches and CPUE in the artisanal line fishery in Maputo Bay, Mozambique, in the years 1999-2010. The aim was also to investigate if the species composition had changed during this period. For two of the already known main species in the catches, Silver sillago (*Sillago sihama*) and Saddle grunter (*Pomadasys maculatum*), length distributions were examined to investigate if smaller fish were observed in recent years. Data used were official catch statistics and length measurements from the PESCART database. The results showed that the much higher catch and CPUE in the years 2009-2010 than in the years 1999-2008 were due to changes in both the area used and the allocation system. Therefore, the study was limited to Maputo district. In Maputo district the catches have been relatively stable in these years at around 70 tonnes. The CPUE has been around 10 kg/gear/day. During the study period 3 species namely Saddle grunts (*P. Maculatum*), Silver sillago (*S. Sihama*) and Javelin grunter (*Pomadasys Kaakan*) have been dominating in the catches comprising 50-75% of the catches. Saddle grunts and Silver sillago are captured both as juveniles and as adults. Based on available data it is not possible to conclude about the state of the stocks for these two species. Further research on the biology of the species is recommended.

This paper should be cited as:
Incio, A.M.A. 2012. *Catch and CPUE trends in the artisanal line fishery in Maputo bay, Mozambique, in the year 1999-2010, and analysis of the two main species; Saddle grunt (Pomadasys maculatum) and Silver sillago (Sillago sihama)*. United Nations University Fisheries Training Programme, Iceland [final project].
http://www.unuftp.is/static/fellows/document/alice11prf.pdf

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1 INTRODUCTION

Species of the Haemulidae (Grunts) and Sillaginidae (Smelts Whiting) families are widely distributed in tropical and subtropical regions of the Indian, Pacific and Atlantic oceans, where they all contribute to local fisheries (Fishbase 2011). In Maputo Bay, Mozambique, species belonging to these families are caught by the artisanal line fishery and as by-catch in beach seine and semi-industrial fishery, which is mainly targeting shrimp. Silver sillago (*Sillago sihama*) is a coastal species, which often enters estuaries. It is common along beaches, sandy substrates, mangroves and estuaries (Bianchi 1985, Mckay 1992, Fisher *et al.* 1990). The main gear used in the Silver sillago fishery is the line fishery, however it can be caught with other gears such as gill nets, drag and cage. In Maputo Bay Silver sillago is caught in sizes ranging from 5-31 cm depending on the gear practiced. The smallest sizes are found in the beach seine catches. Most of this species is caught in sizes ranging between 10-25 cm of total length.

Saddle grunt (*Pomadasys maculatum*) is a species that occurs in coralline substrate, but can occur in areas near the mangroves (Fisher *et al.* 1990). In Maputo Bay this species is mainly caught by artisanal line fishery, but is also caught in smaller amounts in beach seine and gill nets. The size range in the catches is from 5-30 cm of total length, where fish of 10-20 cm is most commonly caught. Juveniles are mostly caught in beach seines close to the sand banks and in areas along the mangroves in depths less than five meters. Adults are caught in areas far away from the coast along the Mozambican canal.

In the artisanal line fishery everyone can participate given they have got the obligatory fishing license. The number of participants in the artisanal fishery has been increasing in the last years.
In Maputo province artisanal line fishery represent 10 % of the total catches in artisanal fishery (IIP 2008, IIP 2009, IIP 2010). Silver sillago (*S. sihama*), Javelin grunter (*Pomadays kaakan*), and Saddle grunt (*P. maculatum*) are the most important species in the artisanal line fishery in Maputo Bay. In the years 2008 to 2010 these species contributed in 11-16%, 21-27% and 6-11% of total catch. (IIP 2009, IIP 2010, IIP 2011).

The current status of the Saddle grunt and Silver sillago in Maputo Bay and in Mozambique coast is largely unknown. In this study, using data from the years 1999-2010 a review of catch and CPUE was done. The sampling program for the artisanal fishery was initiated in 1999. An analysis of length distributions for Saddle grunt and Silver sillago during the same period was also done.

1.1 Description of study area

Maputo Bay is located in southern Mozambique, between 25° 55' S and 26° 10' S and 32° 40' E and 32° 55'E. The size of its area is 1035 km^2 and a part of the bay is an estuarine ecosystem. The depth in the bay ranges from 10 m to 20 m. Two different water masses have been identified in the bay during the rainy season, namely an estuarine water mass in the west and an oceanic water mass in the east. The climate of the Bay is subtropical, characterized by two seasons, hot, wet and humid (October to March) and warm and dry (April to September). The average annual precipitation is about 1100 mm and temperature throughout the year varies from 24°C to 31°C with a humidity range of 59 % - 82 %. Maximum water temperature of 27°C occurs from January to February (Bandeira 2000).

In Maputo Bay habitats like estuarine, mangroves, sea grass beds, coral reefs and the offshore sea can be found. Some important rivers flow into the estuarine such as the Incomáti from north, Umbelúzi, Tembe and Matola on the west and Maputo River on the south (Figure 1).

These rivers stimulate the biological productivity of the Bay due to its discharge regime providing high levels of nutrients. Biological productivity of the bay is also stimulated by the presence of mangroves on the shoreline and seagrass. As a result, the bay supports abundant populations of fish, crustaceans and molluscs (Paula e Silva *et al.* 1993).

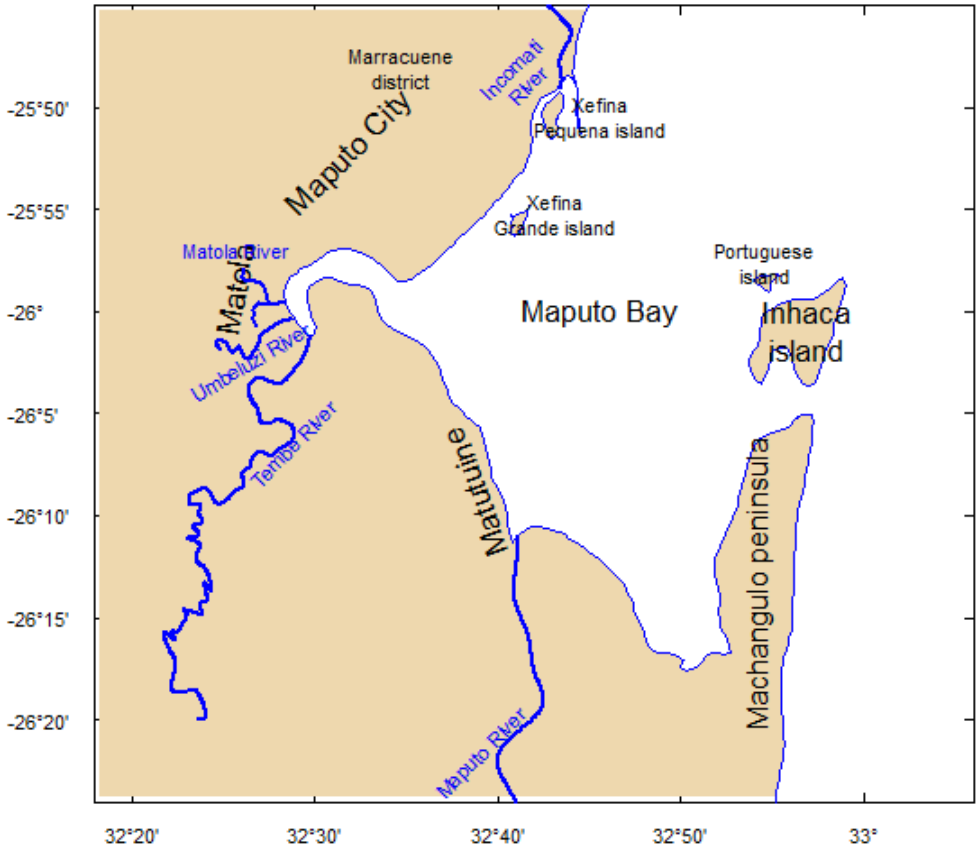

Figure 1: Geographical location of Maputo Bay and its contributing rivers.

2 DESCRIPTION OF THE FISHERY

Two types of fishing fleets operate in Maputo Bay, a semi-industrial fleet whose main target is the shallow water shrimp and an artisanal fleet that is multi-specific and multi-gear activity.

The semi-industrial fishing takes place in areas more than three nautical miles away from the coast (however within sight of the coast). The boats are 8-20 m long and have a power up to 350 hp or 359 kW. Ice is used for conservation of fish on board (RGPM 2003).

The artisanal fishery is practiced in all districts both in coastal and inland waters, though mainly in Maputo Bay. The fishery is limited to the districts of Marracuene, Maputo city, Catembe, Matutuine including Machangulo Peninsula on the eastern, and the Inhaca and Portuguese island (Figure 1). The fishery can be conducted with or without boats. Among the latter, about half are collectors, divers or exercise other activities close to fishing grounds. In addition to these fishermen, there are processors, artisanal naval carpenters, net-makers, naval mechanics and sellers of fishing gear.

The artisanal vessels are up to 10 m long. They can be powered by paddle, sail and by outboard or inboard engines, not exceeding 100 hp or 75 kW (RGPM 2003). The fishery mainly takes place up to three miles away from the coast, but the boats powered by engines can go as far as five miles from the coast. Ice is rarely used for the conservation of fish on board. The number of fisherman range from 1 to 11 depending on the size of the boats and the type of gear used. The catch is sold in local markets.

The lines used are monofilament between 80 and 100 m long. The hooks are variable in size but in the open sea they are bigger than those used in the estuaries. The line length depends on the depth of the fishing zone and size of hooks is also variable and depends on the target species. One or more hooks are attached to each line. Usually, the fishers leave the landing sites during the outgoing tide and return on the incoming tide. The range of stay at sea is from 5 to 11 hours. The catch is unloaded at the landing sites (fishing centres) along the shore of the bay and is sold in the local market.

According to the census of artisanal fishing in maritime waters conducted by the National Institute for the Development of Small-Scale Fisheries (IDPPE) in 2002 and 2007, 66 vessels were used in the line fishery in Maputo Bay in the years 1999-2006 (IDPPE 2004). From 2007 up to date the number of line fishing boats increased to 209 (IDPPE 2009). This “counting” is done every five years and the next is planned for 2012. The size of the vessels and the length of the lines remained the same, and also the size of canoes, boats or flat boats (chatas). The number of vessels powered by engine or by engine and sail has however increased and therefore they are able to reach fishing grounds farther away.

2.1 Statistical data collection

In the province of Maputo the system of collecting statistical data of artisanal fishery started in the year 1999. It is implemented in four of the five coastal districts, namely Matutuine, Marracuene, Maputo and Matola (Figure 1). The data are stored in the PESCART database. In the years 1999-2006 there were 21 fishing centres around Maputo Bay but samples were taken from only 4. These were the fishing centres of Costa do Sol, Muntanhana, Maritimo and Catembe (Figure 2). The catch statistics in these years refer only to the sampled centres. In the years 2007-2009 the number of sampled fishing centres increased from 4 to 17. In these years the catch statistics refer to the sampled centres, like in the years 1999-2006. In the year 2010 an allocation system was

introduced. Data from sampled centres were allocated to none sampled fishing centres of the same district to obtain estimates of catch throughout the district.

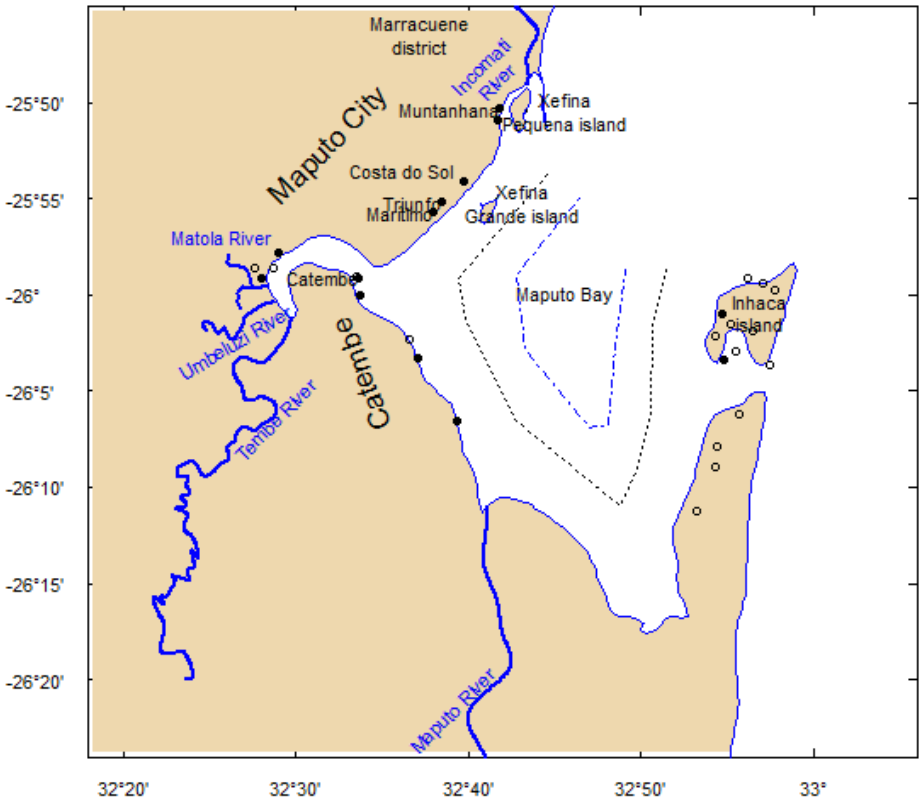

Figure 2: A map showing the sampled (filled circles), non-sampled fishing centres (open circles) and fishing grounds of the artisanal fishery. The fishing centres sampled through the whole study period are named. The dotted lines show the distance from coast at 3 and 5 nm.

2.2 Sampling on the fishing centres

The methodology used for the collection of statistical data is stratified random, where fishing centres nearest and with similar characteristics are grouped together to form one stratum. A team of two samplers or a sampler covers each stratum with a recorder (Baloi *et al.* 2007). The days when sampling shall take place, fishing centres and the boats to be sampled are randomly selected.
In each fishing centre, fishing effort, gear (active and not active), hydro-meteorological data and marketing data are recorded (Appendix 1). For each fishing unit (vessel or fisherman) type of gear, type of boat, number of fishermen per boat, length of gear, size of mesh or hook capture and species composition are recorded (Appendix 2). The species subject to monitoring are length measured (Appendix 3). The main species that are length measured are Silver sillago (*S. sihama*), Saddle grunt (*P. maculatum*), Kelle shad (*Hilsa kelee*), White prawn (*Penaeus indicus*) and Speckled shrimp (*Metapenaeus monoceros*). After the evaluation of the quality of data, which consists of verifying that all fields of the form are properly filled in (see Appendices 1 to 3) (Baloi

et al. 2007), the data are stored in the PESCART database. A team consisting of a supervisor (biologist) and a technician verify the data.

3 MATERIALS AND METHODS

Total catch, fishing effort, size and age structure of the catches is important for population dynamics analysis (Haddon 2011, Gulland 1977). For this study age data were not available but catch, effort and length data were. Data from two data sources were used in this project. First, catch data and CPUE were extracted from published fishery statistics produced by IIP. Second, both catch and CPUE data and length measurements were extracted from the PESCART database. The data extracted from the PESCART database were imported to R, so an analysis could be done within the R framework.

A description of how to convert catch data from the PESCART database to yearly catches was available but it was impossible to get the same number as in the official tables. So a better description of the transformation was needed. Therefore all analysis regarding catch and CPUE is made with data from official tables.

It was decided to use the length measurements from the database for both species to plot length distributions by year and by month. Data were however not available for all years. There were no records in the years 2002 and 2003 for Silver sillago and samples were not available from all months in every year. Length data for Saddle grunt was available since the year 2004 but not for all months. Length distributions were plotted by months and by years to see if there were modes that could correspond to age groups.

All plots were made in the R framework. The maps were made using the geo package in R. The coordinates of the rivers were extracted from Google maps and imported to R.

4 RESULTS

4.1 Catch and CPUE

The catch and CPUE trend in the artisanal line fishery in Maputo Bay, during the study period (1999-2010) is presented in Figure 3 and Appendix 4. The highest value of both catch and CPUE was recorded in 2009 and the lowest in 2003 (Figure 3). The increase in catches between the years 2008 and 2009 is more than threefold. The reason could be related to the change in the system of processing of statistical data, but in the year 2009, data from the processed data centres were allocated to the not sampled fishing centres in the same district in order to get an estimate of the catch for the whole district.

In order to have comparable data it was decided to limit the data to Maputo district, as sampling was made in the fishing centres Costa do Sol, Maritimo and Triumfo throughout the period. The catches from Maputo district are shown in Figure 4 and Appendix 4. The average catch in the years 1999-2010 was around 70 tonnes. Very low catches were reported in 2000, 2003 and 2006. The catches in 2009 were the highest in the time series, just like when the data from the whole bay was used, but still only half of it. So it really matters which data are used.

The fishing effort has also shown high and low values during the period under analysis. The highest values was recorded in 1999, 2001, 2009 and 2010, and the lowest value was observed in 2000 (Appendix 4).

In the district of Maputo the CPUE has been close to or below 10 kg/gear/day in most years. In the years 2005 to 2008 it was almost constant. It reached a maximum value of 20 in 2009, which is higher than the CPUE for the whole bay (Figure 4). In relation to the CPUE, three peaks were observed in the years 2000, 2004 and 2009. The CPUE was at low levels in 2002, 2003 and 2010.

Figure 5 shows the catches from the artisanal line fishery by years and months in Maputo district from 1999 to 2010. As noted before the catches in 2009 are high. The biggest part was taken in the first three months of the year. In general it looks like the catch is higher in the first half of the year than the second half.

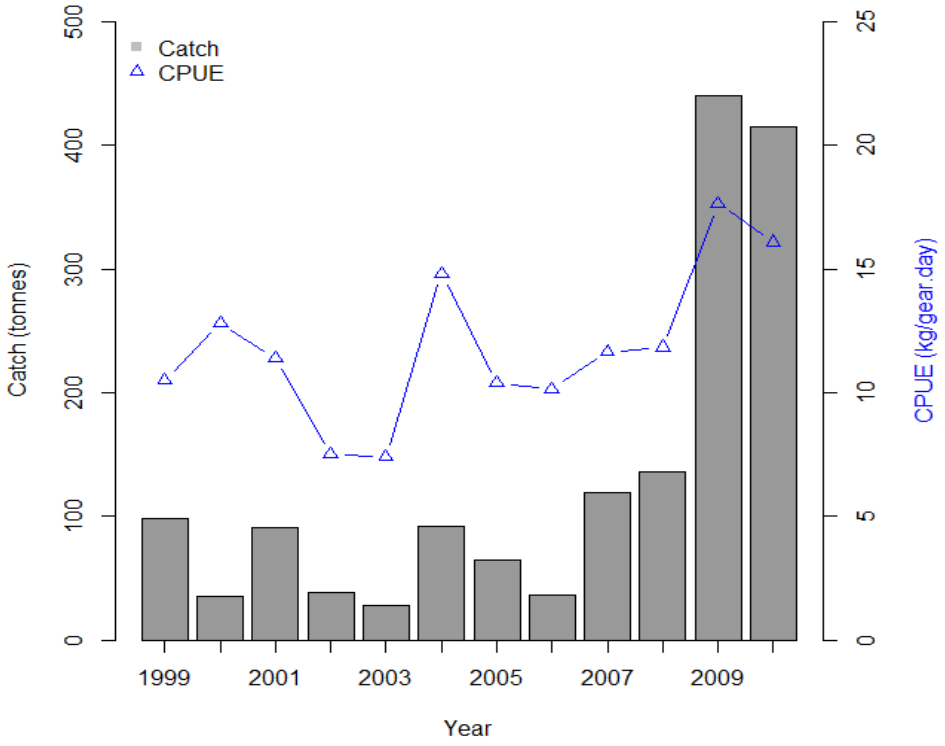

Figure 3: Catch (tonnes) and CPUE (kg/gear/day) in the artisanal line fishery in all Maputo Bay

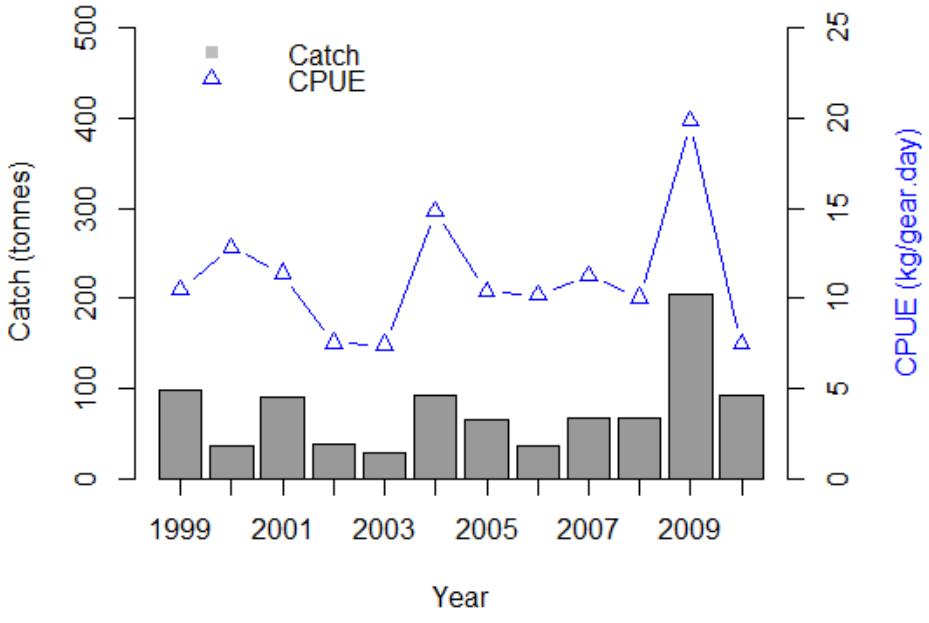

Figure 4: Catch (tonnes) and CPUE (kg/gear/day) in the artisanal line fishery in the Maputo district.

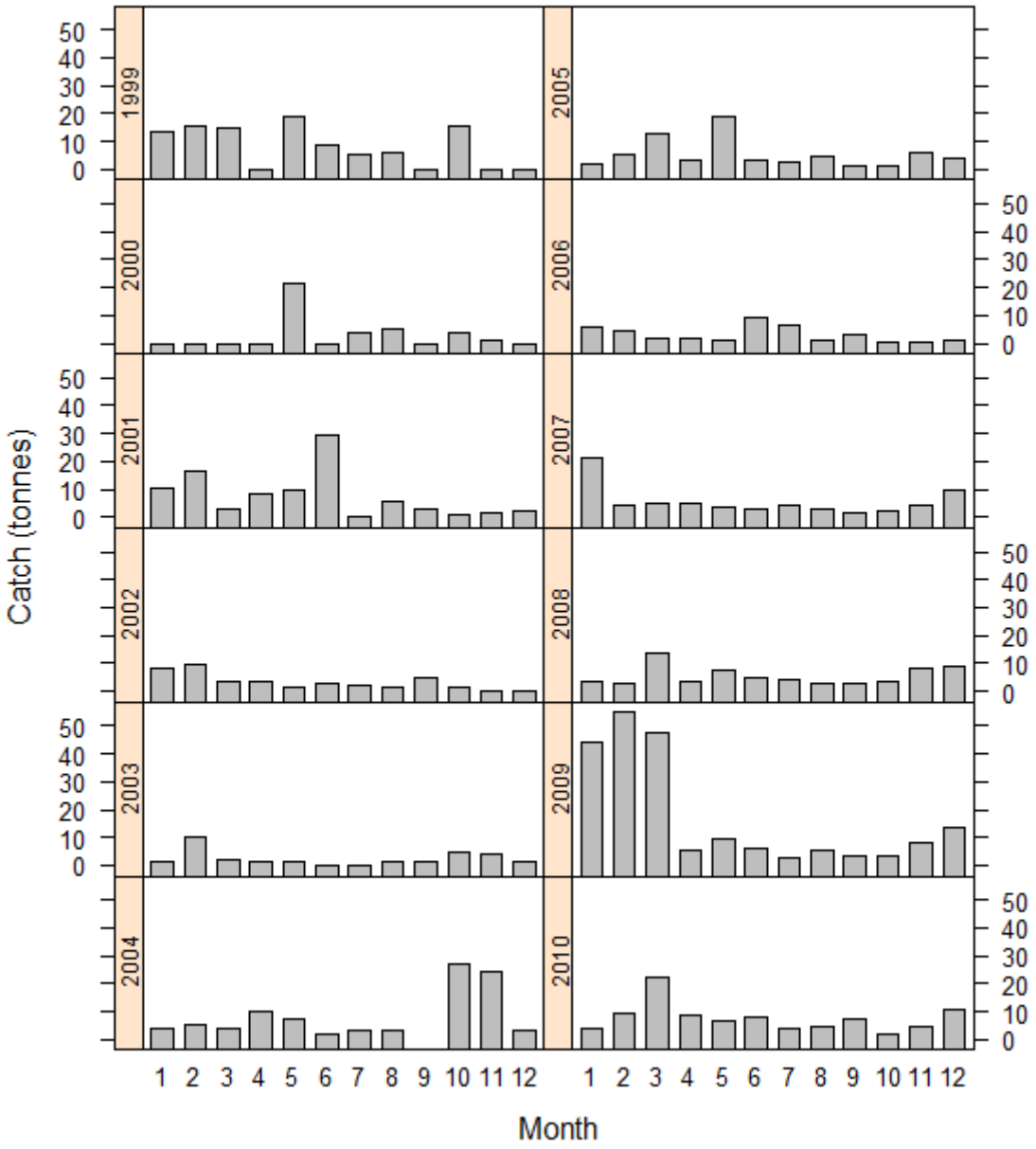

Figure 5: Catches by month and year in Maputo district in the artisanal line fishery.

4.2 Species composition

Monthly catches of the two species Saddle grunt and Silver sillago are shown in the Figures 6 and 7. The highest catch of Saddle grunt was recorded in 2006 and the lowest in 2000. January, February, March, November and December were the months with the highest catches (Figure 6 and Appendix 5). For Silver sillago, the highest catches were recorded in 2009 and 2010 and lowest in 2002 and 2003. Highest catches were recorded in January to May (Figure 7 and Appendix 6).

The species composition as percentage of the yearly catches is given in Table 1. This splitting of the catches is made with the data for the whole bay.

During the study period 3 species have been dominating the catches. These were Saddle grunter (*P. maculatum*), Silver sillago (*S. sihama*), and Javelin grunter (*P. kaakan*) comprising around 50-75% of the catches. The Saddle grunter was at a maximum in the year 2003, but has been declining steadily since then. The Javelin grunter was at low levels during the years 2002-2006, but has been increasing since then. The Silver sillago was at high levels in the years 2000, 2005 and 2006, but in all other years it was close to 15%. These 3 species are followed by Tigertooth croaker (*Otolithes ruber*), which was almost 20% of the catches in the year 2000 but has declined to about 5% in the year 2010. Other species were noted in low percentage.

The 'other group' represents the species that jointly contributed less than 10% of the total catches at the beginning of the study period. In the last four years (2007-2010) this has increased to 15-20% of the total catches. In other years this group contributed only about 8% of the total catch.

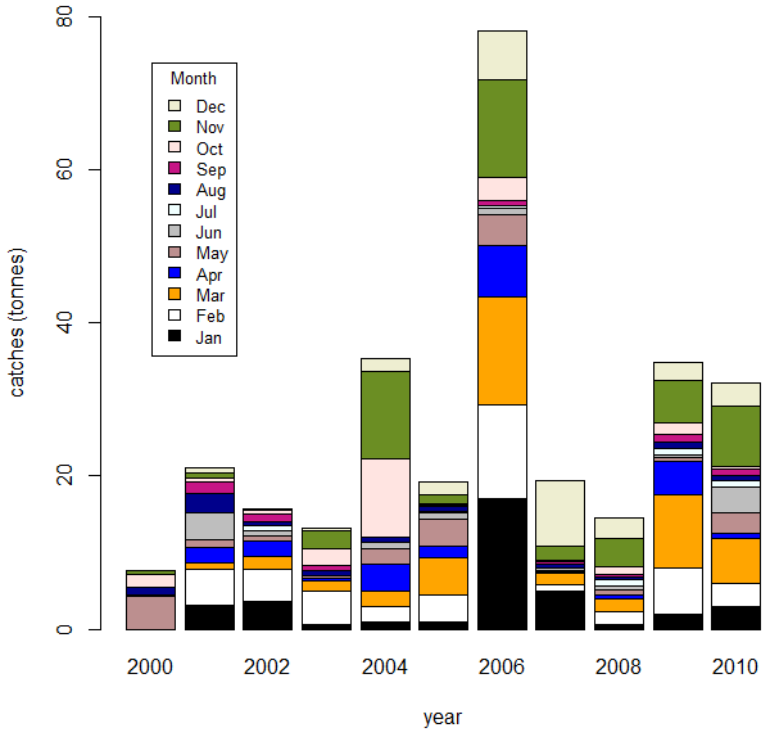

Figure 6: Monthly catch (tonnes) of Saddle grunt (*P. maculatum*) in the years 2000-2010.

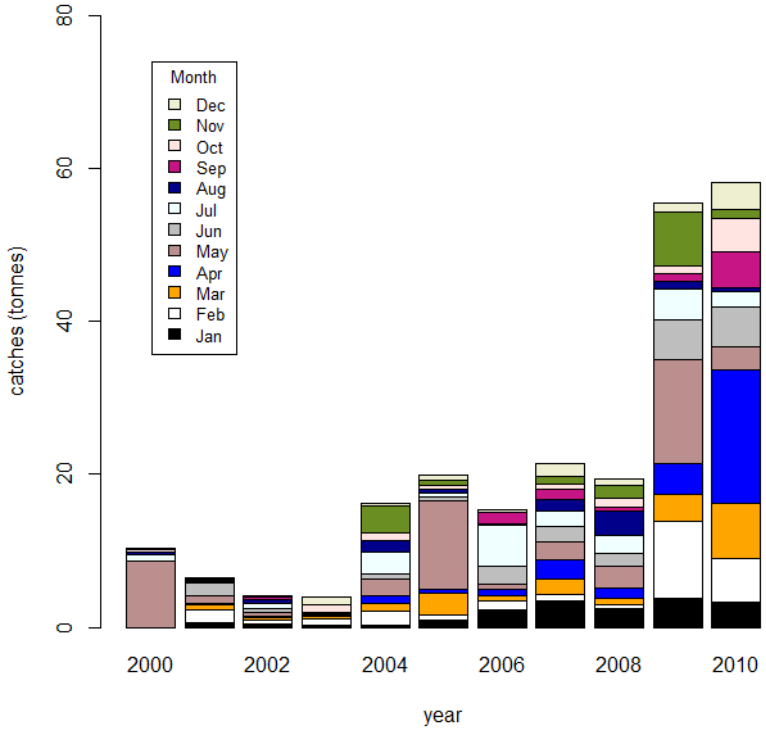

Figure 7: Monthly catch (tonnes) of Silver sillago (*S. sihama*) in the years 2000-2010.

Table 1: Temporal catch (% of biomass) of the most important species in the artisanal line fish in Maputo Bay

Family	Species	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Sillaginidae	Sillago sihama	29.2	7.0	10.9	14.3	17.6	30.6	42.9	18.1	14.1	11.6	16.7
Haemulidae	Pomadasys maculatum	21.7	23.1	40.9	46.9	38.4	29.6	16.7	16.4	11.3	8.0	6.7
	Pomadasys multimaculatum	0.0	2.9	3.6	0.0	0.0	0.0	6.3	1.1	0.0	0.0	0.0
	Pomadasys kaakan	13.6	24.9	9.2	13.7	13.5	8.8	8.8	15.5	21.9	28.4	27.4
Scianeidae	Otolithes ruber	17.8	15.0	8.5	8.7	14.2	6.5	4.5	12.0	9.8	8.6	5.4
	Jhonius dussumieri	0.8	0.0	0.0	0.0	1.3	0.0	0.0	2.0	3.5	1.3	0.0
Carangidae	Scomberomorus commerson	0.3	0.0	0.0	0.0	0.0	0.0	0.0	4.2	7.4	6.2	12.7
	Alepes djedaba	3.8	3.2	0.7	1.6	1.3	4.7	2.2	0.0	0.0	0.6	0.0
Teraponidae	Pelates quadrilineatus	0.0	1.0	0.9	2.9	0.9	1.8	1.3	1.3	0.6	1.1	1.1
	Terapon jarbua	0.4	2.4	0.0	1.4	0.9	1.2	1.6	1.1	0.0	0.0	0.0
Platycephalidae	Platycephalus indicus	0.7	0.7	1.5	0.5	0.3	2.3	1.0	0.9	0.8	1.1	0.9
Muranesocidae	Muraenesox bagio	0.0	1.2	1.2	0.0	0.6	1.5	4.9	5.8	11.4	5.7	6.2
Leignathidae	Leiognathus equulus	1.5	7.1	10.4	2.8	2.2	1.3	1.6	3.3	0.9	0.8	1.0
Sparidae	Crenidens crenidens	0.7	1.6	3.2	0.8	0.0	1.1	1.9	0.0	3.2	3.6	3.4
Others	Others sp	9.5	9.8	8.9	6.6	8.6	10.6	6.2	18.2	15.2	23.0	18.4

4.3 Length distribution

4.3.1 Length distribution by year and by month

Prior to the discovery of daily and seasonal rings in otoliths and scales, the analysis of length-frequency data was the only method that could be applied to draw inferences on the growth of tropical fishes (Longhurst and Pauly 1987). As no age readings exist for the two species under consideration length distributions have been plotted.

Length distributions of Saddle grunt (*P. maculatum*) based on samples taken in the artisanal line fishery in the years 2004 to 2010 are presented in Figure 8. In all years the distributions showed that individuals in sizes between 10 and 15 cm are most common. The figure also shows that only few individuals in the extreme are caught, that is, less than 10 cm and greater than 20 cm. As line is a selective gear this indicates less variability in the size of the hook. By looking at the length distribution in 2004 one can suggest that there are at least three peaks in the distribution, at 10, 13 and 17 cm.

The length distribution of Silver sillago (*S. Sihama*) based on samples in the artisanal line fishery in the years 2000 to 2010 is shown in Figure 9. It shows that this species is captured in sizes ranging from 15 to 20 cm of total length. Despite the low number of individuals the figure shows the presence of juveniles in the catch in 2007.

In the years 2005 and 2008-2010 samples were taken monthly. The length distributions for Saddle grunt are shown in Figures 10 to 13 and for Silver sillago in Figures 14 to 17. In 2009, the length distribution for Saddle grunt shows two peaks in January to April in the size classes of 10-12 cm and 14-15 cm, suggesting the presence of at least two cohorts (Figures 10-13).

For Silver sillago the figures show in general that the first half of the year is characterized by increased number of individuals compared to the second half. Although 2010 showed distribution of number of individuals different from other years showing high numbers almost in all year. The largest number of individuals also allows to observe two modes in sizes 13 cm and 17 cm, the modes are more pronounced in May 2005 and in the months January to April for 2009 and 2010, September to December of 2010 there is also the presence of individuals larger than 20 cm though outnumbered, this scenario is also observed in 2009.

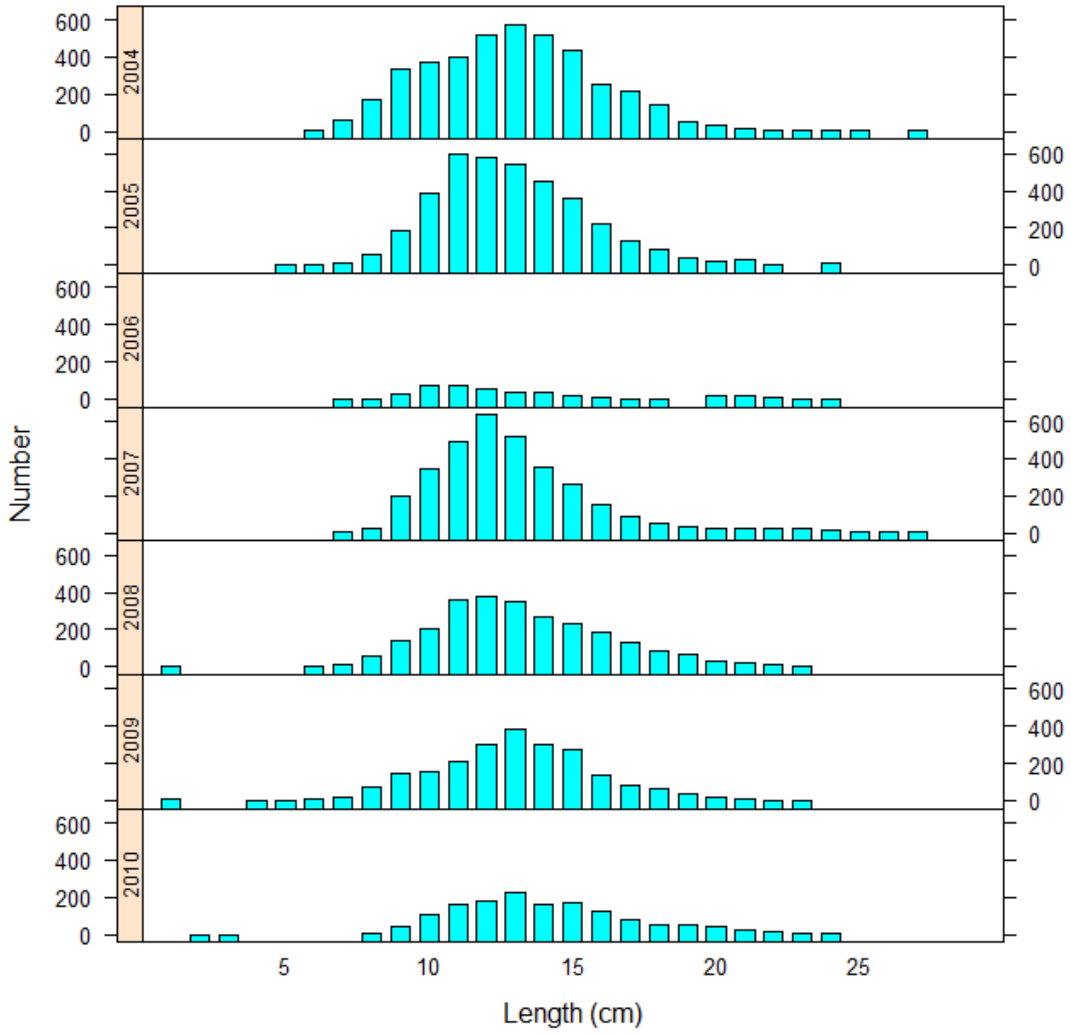

Figure 8: Length distribution by year of Saddle grunt (*P. maculatum*) on Maputo district in the years 2004-2010.

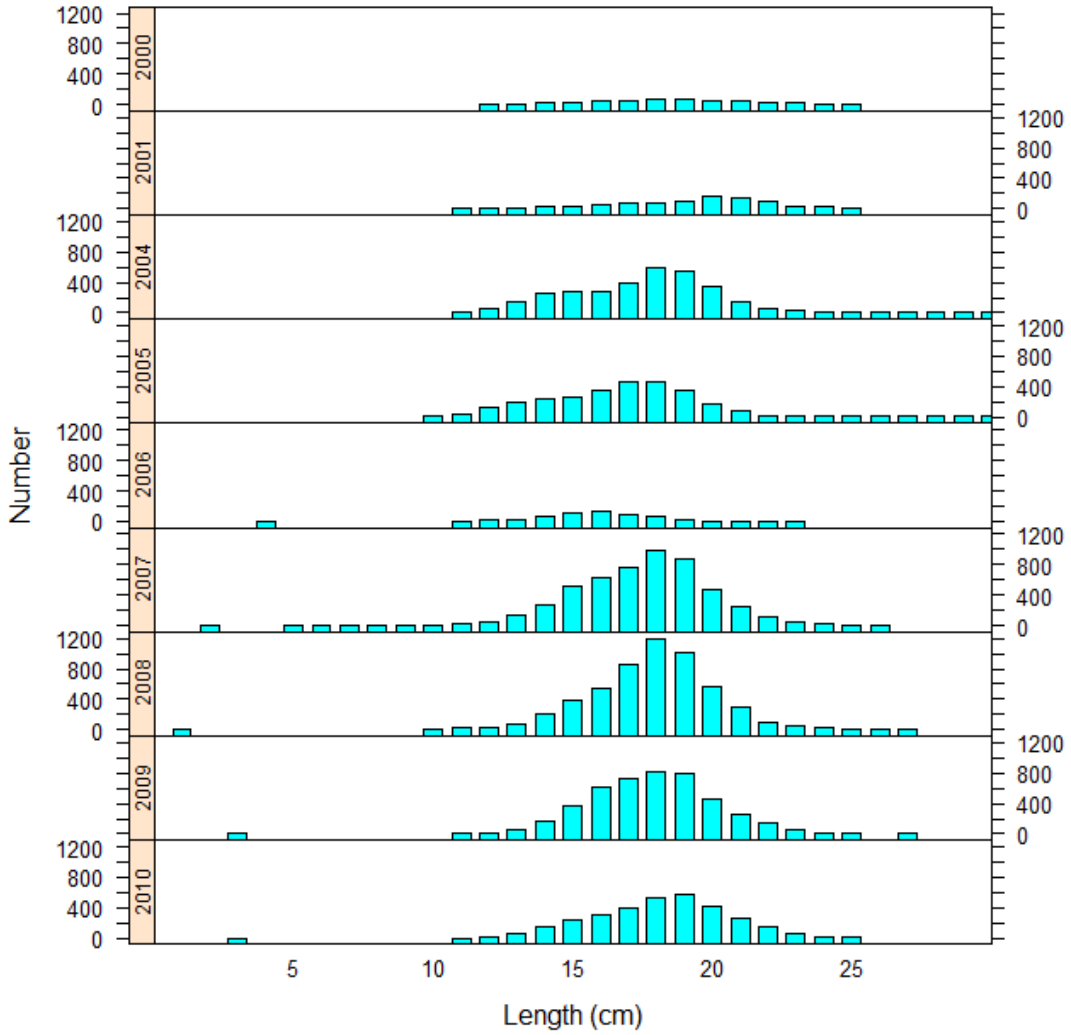

Figure 9: Length distribution by year of Silver sillago (*S. sihama*) on Maputo district in the years 2000-2010.

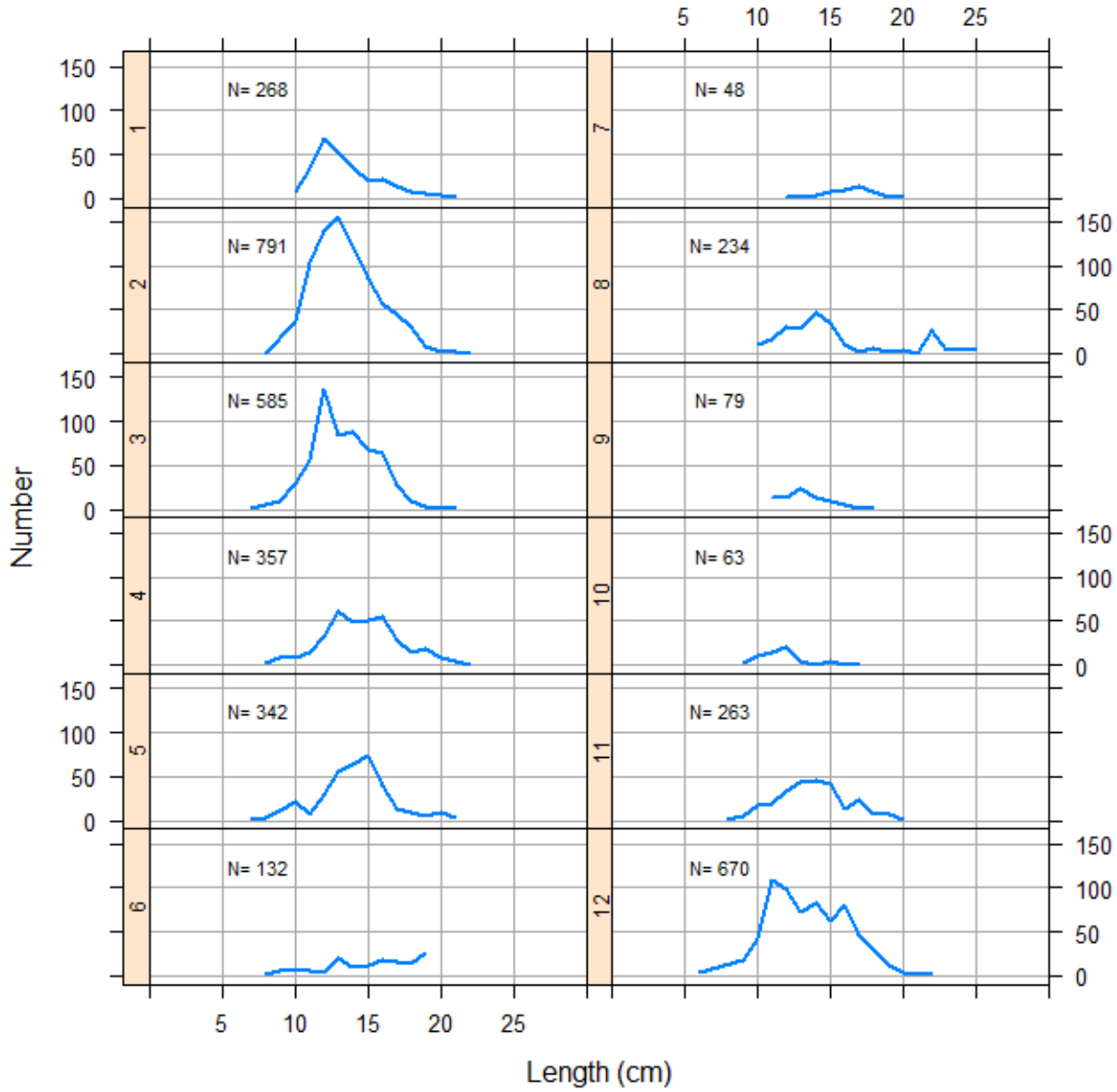

Figure 10: Length distribution by month of Saddle grunt (*P. maculatum*) in 2005 in Maputo district. N denotes the numbers of individuals measured each month.

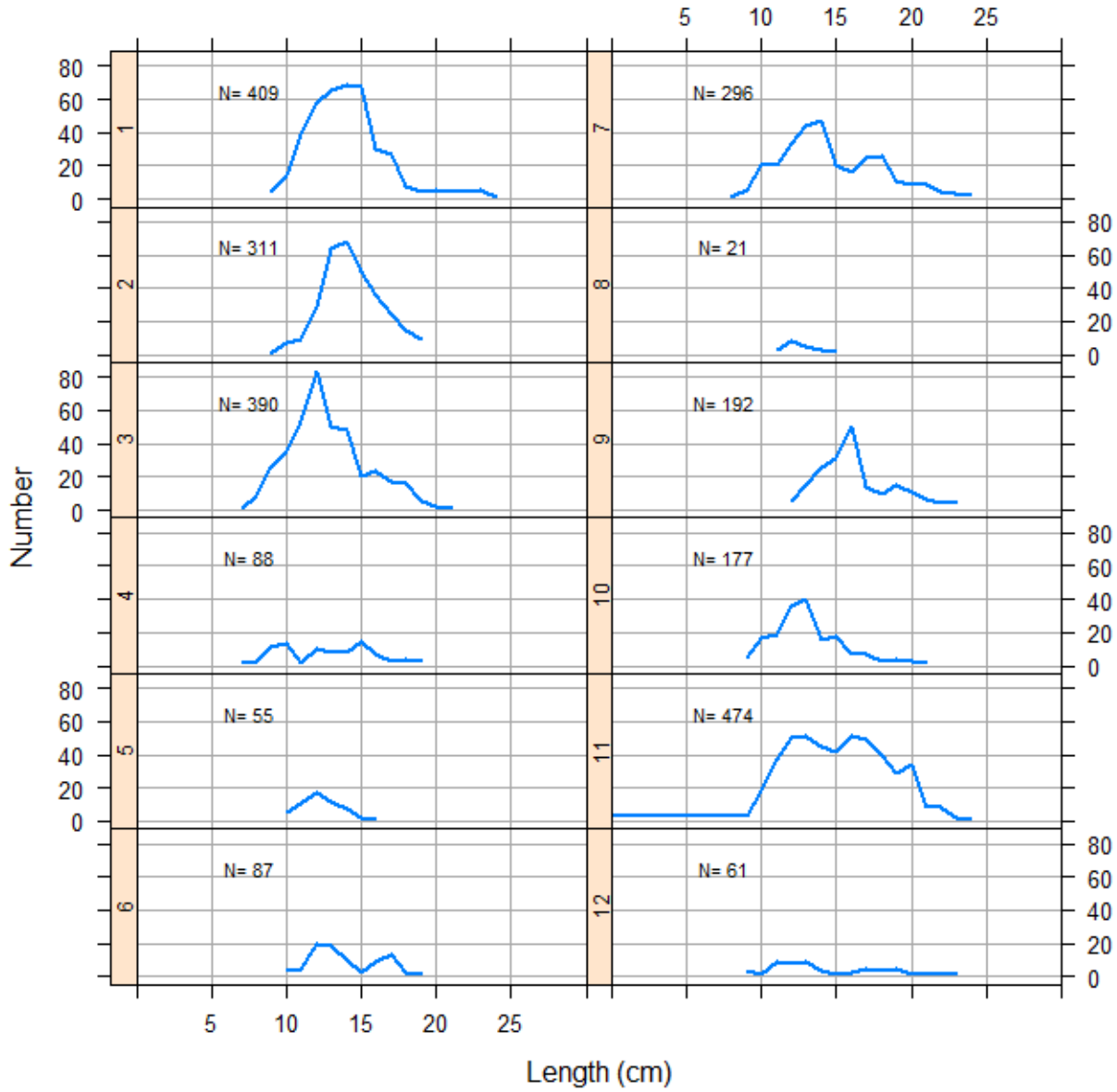

Figure 11: Length distribution by month of Saddle grunt (*P. maculatum*) in 2008 in Maputo district. N denotes the numbers of individuals measured each month.

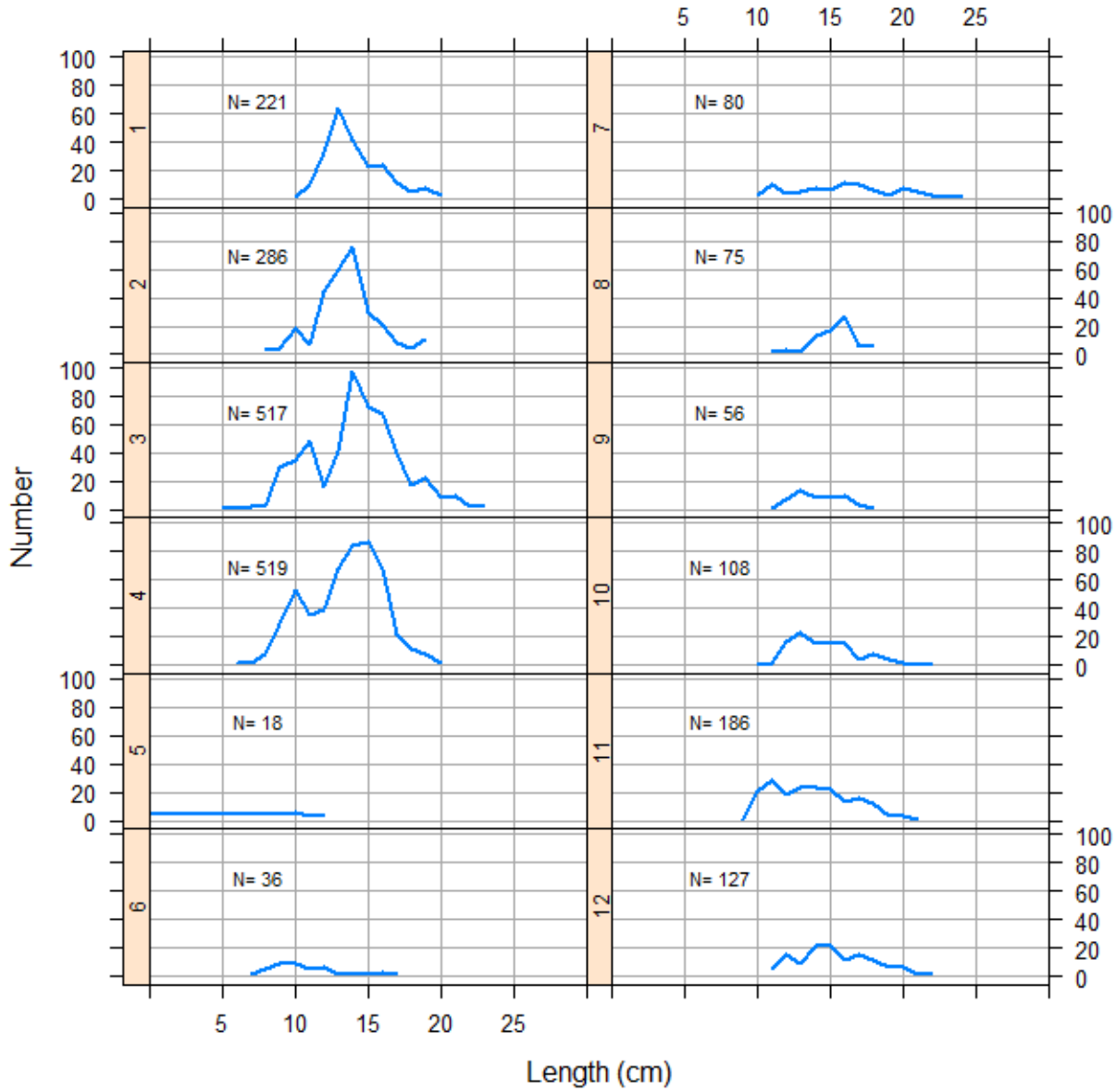

Figure 12: Length distribution by month of Saddle grunt (*P. maculatum*) in 2009 in Maputo district. N denotes the numbers of individuals measured each month.

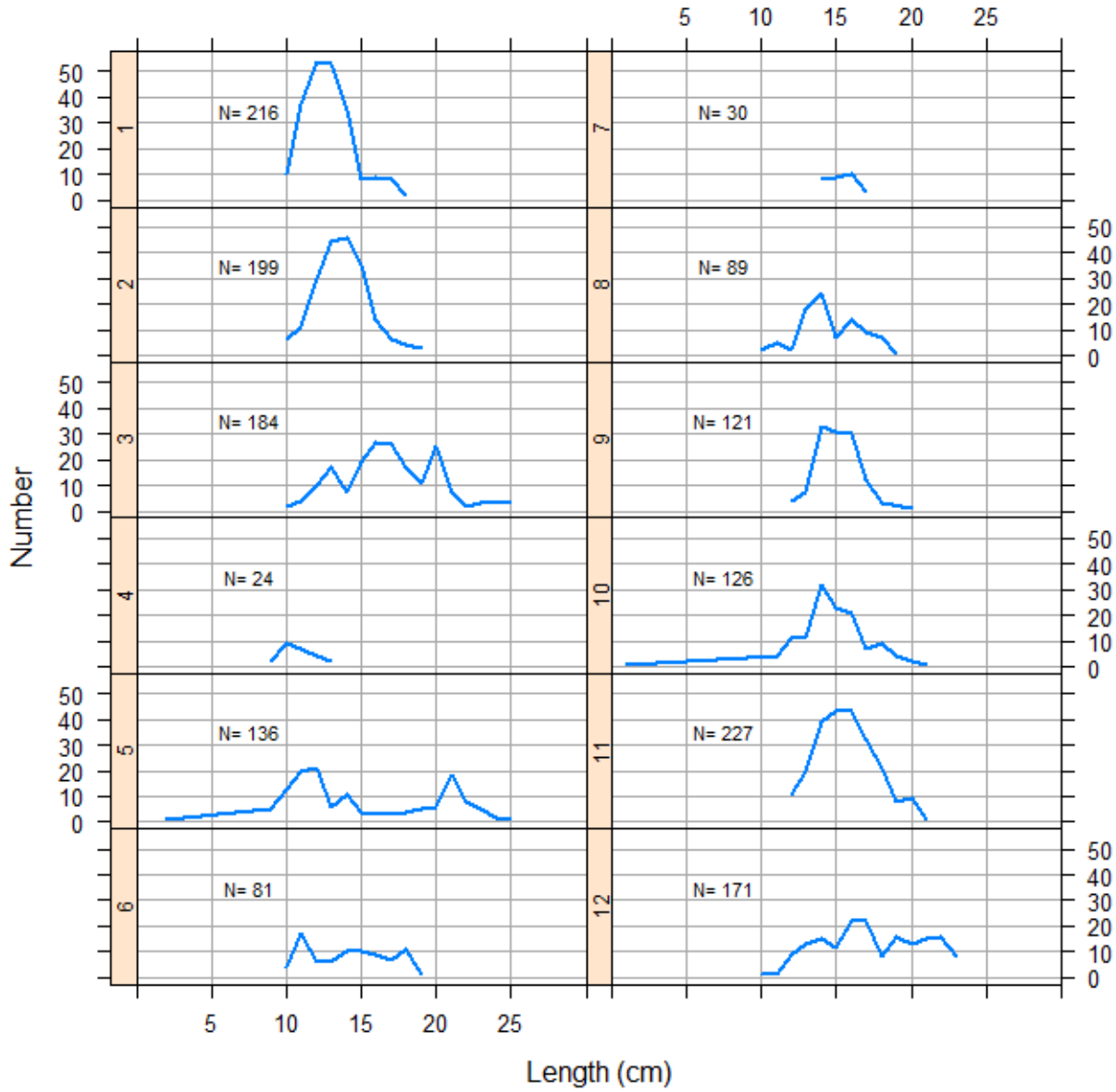

Figure 13: Length distribution by month of Saddle grunt (*P. maculatum*) in 2010 in Maputo district. N denotes the numbers of individuals measured each month.

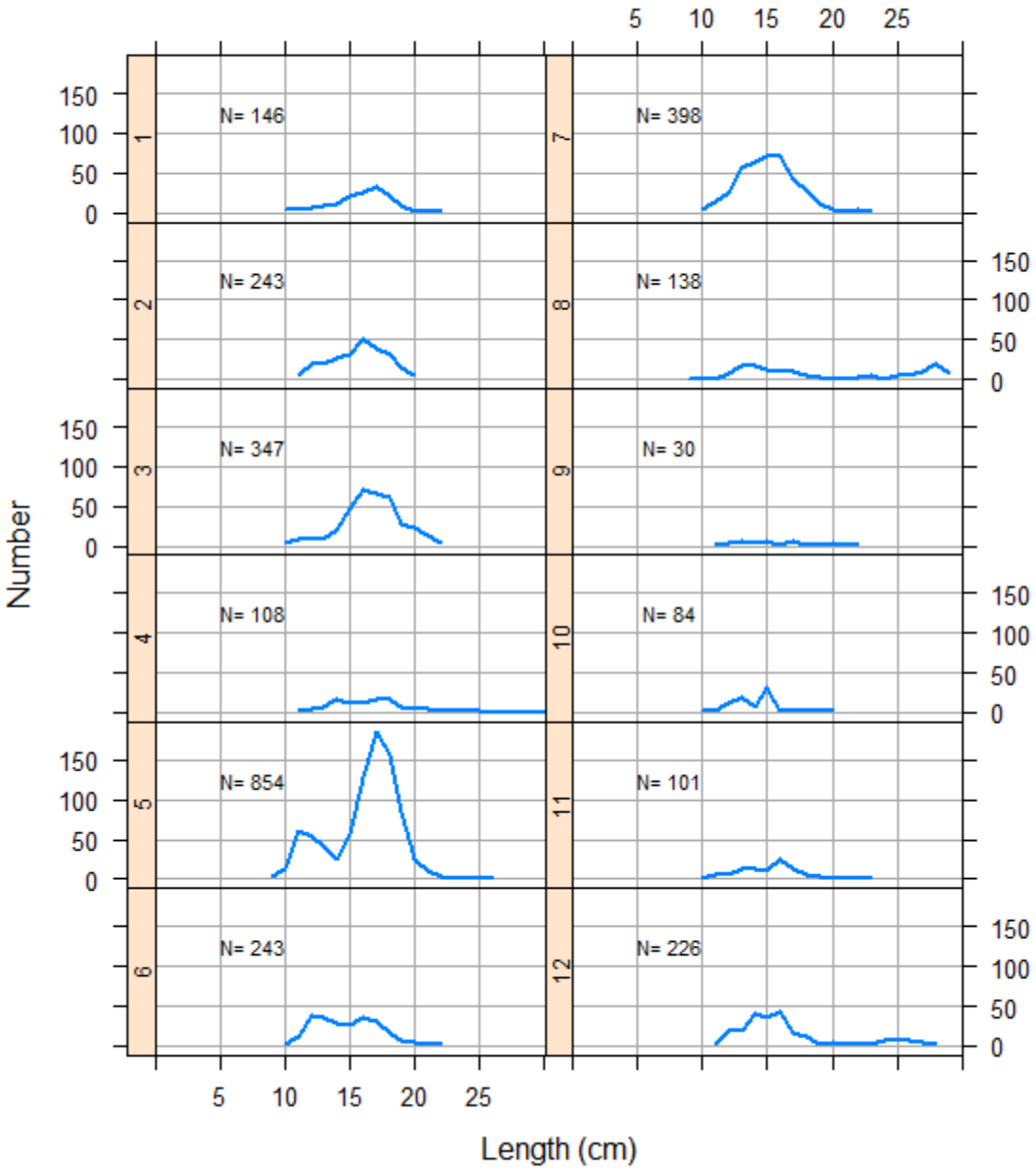

Figure 14: Length distribution by month of Silver sillago (*S. sihama*) in 2005 in Maputo district. N denotes the numbers of individuals measured each month.

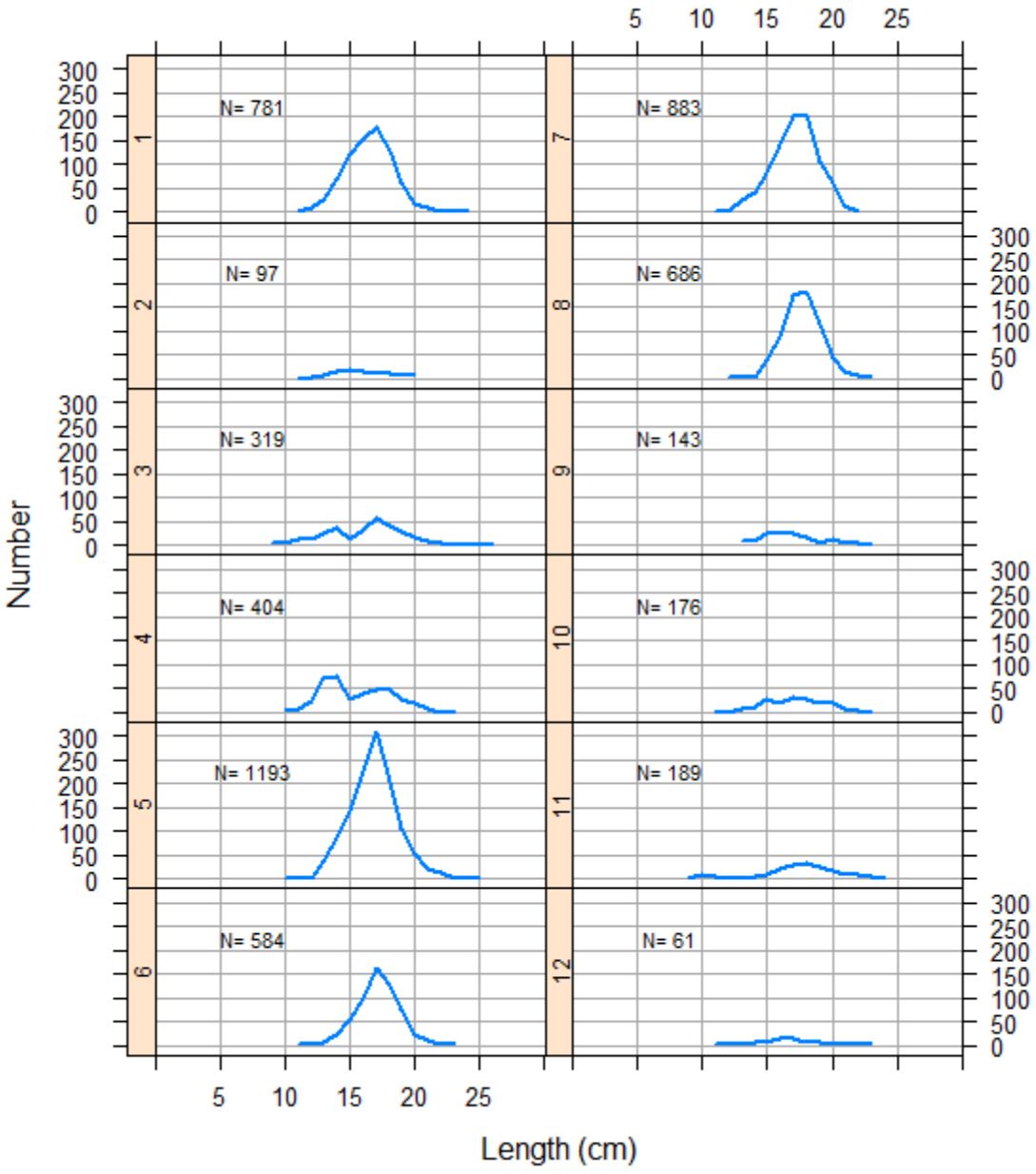

Figure 15: Length distribution by month of Silver sillago (*S. sihama*) in 2008 in Maputo district. N denotes the numbers of individuals measured each month.

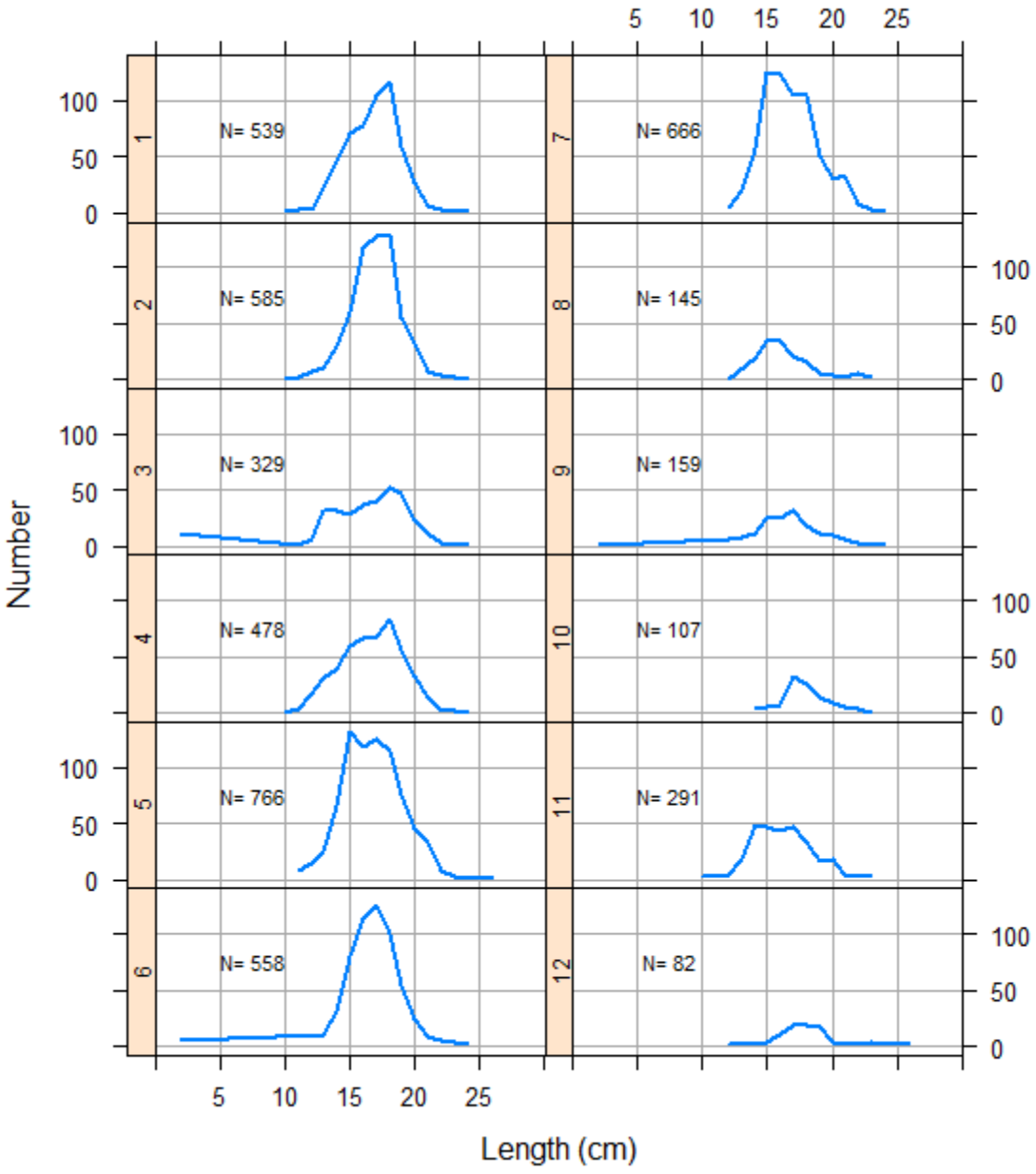

Figure 16: Length distribution by month of Silver sillago (*S. sihama*) in 2009 in Maputo district. N denotes the numbers of individuals measured each month.

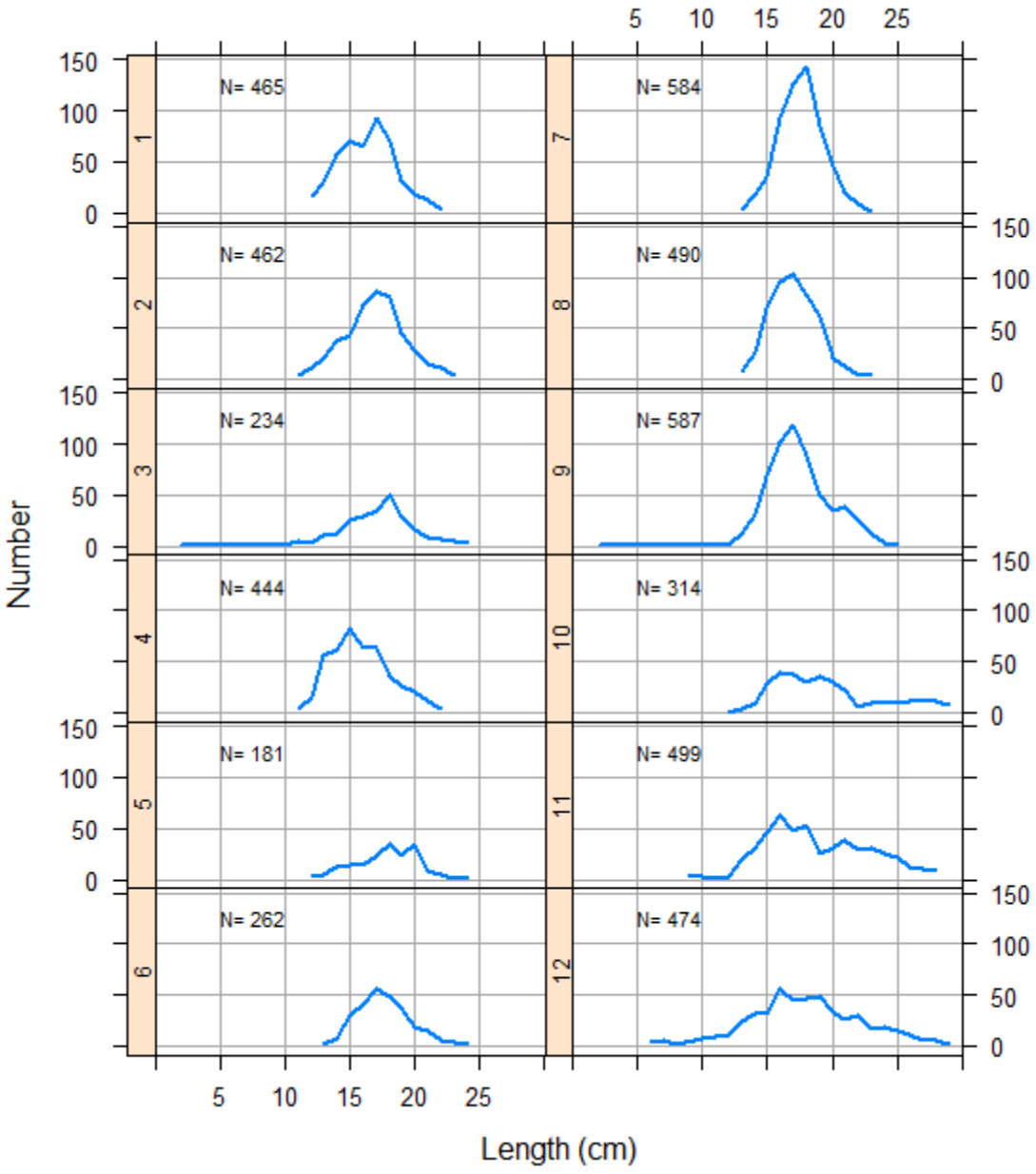

Figure 17: Length distribution by month of Silver sillago (*S. sihama*) in 2010 in Maputo district. N denotes the numbers of individuals measured each month.

5 DISCUSSION

Fisheries in the developing nations are frequently overexploited and catches of many species have either levelled off or are declining (Galluci *et al.* 1996). In Maputo district the catches and CPUE in the artisanal line fishery have been relatively stable with catches around 70 tonnes and 10 kg/gear/day for CPUE in the years 1999-2010. There was a peak in 2009, which was most likely due to the new allocation system. It is impossible to draw any conclusions about the development of the catches and CPUE in the artisanal line fishery in whole Maputo Bay with the available data.

The high catches observed from December to May and the seasonality observed in the catches of two species could be related to river discharge in the rain season resulting in increased availability of nutrients and lower rate of predation related to the turbidity of the waters.

The occurrence of the species in the catches could primarily be dependent on the fishing grounds. On the usual grounds, three nautical miles away from the coast, demersal species can occur in addition to large pelagic species. When the fishing grounds are the estuaries and inshore areas small pelagic species are caught. The changes in the occurrence of the species in the last years can also be related to expanded area in data collection.

In Maputo Bay only one study has been done on the reproductive biology of the species under consideration. Chauca conducted it in 2009. It indicated that Silver sillago begins to mature when it reaches 14 cm of total length and 50% of individuals are mature at 18 cm. According to the same study Saddle grunt begins to mature when it reaches 11 cm of total length and 50% of them are mature at 14-15 cm. In light of this information, about 25% of individuals in the catches of Saddle grunt for the current data set are caught before they start maturing, which means that they are caught as juveniles, 50% of individuals are between the first and 50% of maturity meaning that they are caught in pre-juvenile stage. About 25% of individuals are caught above 50% of maturity, as adults. The maximum size of the species in Mozambique is around 45 cm (Fisher *et al.* 1990), but hardly any individuals larger than 25 cm are seen in the catches. The line fishery unlike the other gear such as gill nets, drag, purse seine, is very selective (King 1999) and it is reflected in the length distributions. This could indicate that the adults are caught at others grounds, like Mozambican canal.

Silver sillago is also caught both as juvenile and adults. The annual distribution of lengths shows that about 75% of individuals are captured below size of 50% of maturity and 25% of the individuals are caught as adults. The maximum length is approximately 31 cm. Individuals up to that length can be seen in the samples.

According to Cushing (1981), eggs and larvae drift away from spawning grounds to nursery grounds, and the adults migrates back to the spawning ground. Therefore, the low percentage of adults in the catches is probably related to the fact that the fishing grounds of the artisanal line fishery is on the nursery area but the spawning and/or feeding areas are outside the fishing grounds.

6 CONCLUSION

The main objective of this study was to have an analysis of catch and CPUE of artisanal line fishery in Maputo Bay and provide a status of the stocks of two main species caught. In Maputo district the catches have been relatively stable in the last 10 years at about 70 tonnes. The CPUE has been stable as well, in most years around 10 kg/gear/day. The main species caught are still the same, however with a changed contribution, which could be related to expanded area in the data collection. The length distributions in the fishery are still the same as 10 years ago so consequently it is concluded that these lengths groups fulfill the demand.

Based on available data it is not possible to conclude about the state of the stocks under consideration. More information about the biology of these species is needed. Therefore, further studies are recommended. This includes that more samples, with biological information are needed. The samples should be taken over the whole year and at more locations.

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ACKNOWLEDGMENTS

I would like to thank my supervisor, Mrs. Asta Gudmundsdóttir for her guidance, help and encouragement during the project and for her valuable criticism. I am deeply grateful to Dr. Tumi Tómasson and Mr Thor Ásgeirsson for giving me the opportunity to participate in the programme and their continued assistance, support and guidance during the six-month period of the training programme. Also thanks to Sigrídur Kr. Ingvarsdóttir for her careful care of my life here. I would also like to thank Paula Santana Afonso, Director of the Institute for Fisheries Research (IIP) in Mozambique for having given me the opportunity to undertake this course. I am grateful to UNU-Fisheries Training Programme for funding this course and allowing me to carry out this course. Thanks to all colleagues of the UNU-FTP course for their criticism on an earlier draft. I would also like to thank my mother to her patience in looking after my sons. I am grateful to all the staff of the Marine Research Institute, UNU fellows and my friends for their help and encouragement during my stay in Iceland. Many thanks to eng. Xavier Manussa, Isabel Chauca, Zainabo Masquine, Alberto Halare, Lucia Sumbane, Antonio Sitoe, Eunice Leong for brevity in the response of all requests addressed related to course. Finally I thank my husband Antonio Miguel for his patience and understanding during my stay in Iceland. To all my family I express my thanks.

APPENDIX

APPENDIX 1: FISHERIES RESEARCH INSTITUTE ARTISANAL FISHERIES DATA COLLECTION FORM - FISHING CENTRE SHEET.

A	Page /

Fishing Centre	Strata	District	Province	Date	Time of Samp.	
					Initial	Final
				____/____/____		

Register

There was fishing activity: Yes No

Hydro meteorological data Wind		
Strength	Direction	Time

Tide		
Type	Level	
	Height (m)	Time
Low tide		
High tide		

Phase of the Moon

Cloudiness	
Grade	Time

Commercialization		
Category	Price (MT)	Unit

Fishing Units				
Type of Fishing Units	Number of Fishing Unit			
	Sampled	Active	Non Act.	Others Fishing Cent.
TOTAL				

Origin of gear (others fishing centre)	

Environmental Factors	Principal	Others

Socio-economic Factors	Principal	Others

General Observationss	

APPENDIX 2: FISHERIES RESEARCH INSTITUTE ARTISANAL FISHERIES DATA COLLECTION FORM - FISHING UNITY SHEET.

B	Page /

Fishing Centre	Strata	District	Province	Date	Time of Sampling	
					Initial	Final
				____/____/__		

Fishing Unit										
Nº	Identification of Unit	Type of Fishing Unit	Type of Vessel	Fishing site	Number of Fisherman	Length		Mesh/hook Size	No bids /Gears	
						Net	Cable		Sampled	Total

Bids Gears landing			
No	Time		Catch (Kg)
	Initial	Final	
TOTAL			

Categories				
No	Category / No	Catch (kg)	Sample	
			No Indiv.	Weight (g)

Species Composition							
No	Category / No	Specie		Sample		Medidos	
		Cod.	Scientific Name / Sex	No Indiv.	Weight (g)	No Indiv.	Weight (g)

APPENDIX 3: FISHERIES RESEARCH INSTITUTE ARTISANAL FISHERIES DATA COLLECTION FORM - LENGTH SHEET

C1	Page /

Fishing Centre	Strata	District	Province	Date	Time of Sampling	
					Initial	Final
				__/___/___		

Length							
No Unit	No	Category / No	Specie / Sex	No Unit	No	category / No	Specie / Sex

Class	Measured Individuals	No	Weight (g)	Class	Measured individuals	No	Weight (g)
0				0			
0,5				0,5			
1				1			
1,5				1,5			
2				2			
2,5				2,5			
3				3			
3,5				3,5			
4				4			
4,5				4,5			
5				5			
5,5				5,5			
6				6			
6,5				6,5			
7				7			
7,5				7,5			
8				8			
8,5				8,5			
9				9			
9,5				9,5			
0				0			
0,5				0,5			
1				1			
1,5				1,5			
2				2			
2,5				2,5			
3				3			
3.5				3.5			
4				4			
4,5				4,5			
5				5			

APPENDIX 4: CATCHES (TONNES), EFFORT (ACTIVE GEAR) AND CPUE (KG/GEAR/DAY) OF ARTISANAL LINE FISHERY ON ALL MAPUTO BAY AND IN MAPUTO DISTRICT.

	All Maputo Bay			Maputo district		
Year	Catch	Effort	CPUE	Catch	Effort	CPUE
1999	98	9336	10.5	98	9336	10.5
2000	35	2757	12.81	35	2757	12.81
2001	91	8002	11.39	91	8002	11.39
2002	38	5125	7.5	38	5125	7.5
2003	28	3775	7.42	28	3775	7.42
2004	92	6207	14.82	92	6207	14.82
2005	65	6251	10.4	65	6251	10.4
2006	36	3544	10.15	36	3544	10.15
2007	119	10173	11.65	67	5972	11.24
2008	136	11460	11.85	66	6601	10.02
2009	440	24966	17.64	205	10317	19.86
2010	415	25748	16.1	91	12206	7.47

APPENDIX 5: CATCHES (TONNES) PER MONTH AND PER YEAR OF SADDLE GRUNT (*P. MACULATUM*) IN MAPUTO BAY.

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	0	0	0	0	4.36	0	0.06	1.04	0	1.75	0.47	0
2001	3.15	4.71	0.84	2.05	0.96	3.54	0.03	2.45	1.52	0.48	0.66	0.64
2002	3.59	4.21	1.62	2.1	0.65	0.75	0.61	0.54	0.96	0.49	0.09	0.12
2003	0.57	4.43	1.25	0.46	0.22	0	0	0.78	0.58	2.27	2.25	0.31
2004	0.98	1.93	2.13	3.5	2.01	0.73	0.04	0.66	0	10.32	11.39	1.66
2005	0.99	3.44	4.85	1.61	3.53	0.8	0.1	0.81	0.11	0.09	1.21	1.68
2006	17.07	12.32	14.01	6.72	4.08	0.79	0.44	0	0.62	2.97	12.76	6.41
2007	4.93	0.83	1.52	0.28	0.07	0.29	0.11	0.53	0.21	0.3	1.79	8.58
2008	0.6	1.63	1.74	0.47	0.73	0.51	0.74	0.35	0.41	0.98	3.77	2.63
2009	2	5.96	9.63	4.4	0.49	0.31	0.87	0.8	0.99	1.48	5.65	2.3
2010	2.9	3	5.92	0.78	2.55	3.43	0.85	0.66	0.9	0.23	7.85	3.14

APPENDIX 6: CATCHES (TONNES) PER MONTH AND PER YEAR OF SILVER SILLAGO (*S. SIHAMA*) ON MAPUTO BAY.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2000	0	0	0	0	8.65	0	0.9	0.34	0	0.27	0.16	0
2001	0.6	1.75	0.63	0.14	1.08	1.67	0.11	0.22	0.02	0.01	0.1	0.07
2002	0.46	0.5	0.24	0.31	0.41	0.61	0.65	0.39	0.41	0.12	0.06	0.01
2003	0.21	0.94	0.25	0.19	0.22	0	0	0.14	0.01	0.91	0.14	1
2004	0.29	1.87	1.02	1.01	2.15	0.67	2.75	1.51	0	1.1	3.47	0.36
2005	0.89	0.8	2.84	0.48	11.48	0.56	0.48	0.48	0.11	0.37	0.83	0.59
2006	2.36	1.08	0.65	0.9	0.59	2.39	5.36	0.25	1.4	0.06	0.05	0.34
2007	3.4	0.92	2.06	2.48	2.34	1.98	1.99	1.56	1.34	0.63	1.06	1.65
2008	2.5	0.46	0.9	1.23	2.92	1.7	2.38	3.15	0.46	1.24	1.65	0.9
2009	3.78	10.05	3.64	4.02	13.47	5.28	4.03	0.99	1.06	0.9	7.16	1.08
2010	3.28	5.69	7.19	17.56	3.01	5.14	2.06	0.53	4.72	4.32	1.23	3.51