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SEASONAL TREND AND ABUNDANCE OF SPARIDS IN GHANAIAN COASTAL WATERS AN ASSESSMENT OF THE ARTISANAL FISHERIES SECTOR

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ABSTRACT

The artisanal fishery in Ghana plays an important role in the supply of domestic fish over the decades. This sector accounts for about 70% of total marine fish landings (pelagic and demersal). Sparids (seabream) are the high value demersal species exploited in Ghana. This study used a 10-year (2001-2010) data set of regional catch and effort of the various gears to examine the seasonal trend and abundance of various species of Sparids landed by the artisanal fishery. It was noted that catches of the major Sparids declined during the upwelling seasons and by-catch of non-Sparid targeting gears is increased, especially the Ali/Poli/Watsa (APW) within the study period.

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1 INTRODUCTION

1.1 Background

Fisheries in the western Gulf of Guinea, have sustained the livelihoods of coastal dwellers and the economy of the Ghana over the years. In Ghana, it accounted for 4.5% of the country's Gross Domestic Product (GPD) and 12% of the Agricultural Gross Domestic Product in 2010. Approximately 60 million US Dollars is earned annually from the export of fish. This sector directly engages about 10% of the total country's population of 24 million. The fisheries sector provides about 60% of the national animal protein need. Fish consumption is 25kg/capita/yr, which is higher than the global average of 17.1kg (MOFA 2011).

The marine capture fisheries are the main source of fish landings in Ghana and accounts for 77% of the total country fish production. Both pelagic and demersal fish stocks exploited by the different fishing fleets operating in the Ghanaian coastal waters are shared by the neighbouring countries in the sub-regions, namely, Benin, Togo and La Cote d'Ivoire.

Large pelagics consist of the tunas, that is *Thunnus obesus* (Bigeye tuna), *Thunnus albacares* (Yellowfin tuna), *Katsuwonu spelamis* (Skipjack tuna) and other tuna like species (Frigate and Atlantic little tunny) and the billfishes made up of *Makaira nigricans* (Blue marlin), *Tetrapturus albidus* (White marlin), *Istiophorus albicans* (Sailfish) and *Xiphias glaudius* (Swordfish).

Small pelagics of commercial importance are the sardinella species (*Sardinella aurita* and *Sardinella maderensis*), *Scomber japonicas* (Chub mackerel) and anchovy (*Engraulis encrasicolus*). Differences in annual landings of the various fleets in the sector are mainly caused by the quantities of these species. The natural fluctuation in abundance of small pelagics is much affected by the strengths of seasonal upwelling (Koranteng 1991).

The increase in fishing effort over time of small pelagics is attributed to the increase number of fishing vessels, gears and increased efficiency of the gears operating over the decades (Minta 2003). Small pelagics are generally believed to be overexploited in spite of the recent increase in landings (Mensah and Quaatey 2002).

Demersal species exploited in the sub-region (Gulf of Guinea) are placed into the categories of coastal demersal and deep-water (200-300m). Coastal demersal communities (Koranteng 1996) inhabit the Gulf of Guinea down to about 40 meters depth (being the lower limit of the seasonal thermocline) and the deep water demersal below the thermocline. Distribution and abundance of demersal fish depend on numerous factors, which include depth and the substrate of the seabed.

The coastal demersal species include the Sparidae (seabreams), Lutjanidae (snappers) and Soleidae (soles). These high value demersal species exploited in Ghana are believed to be unsatisfactorily assessed. However, the increase in overall fishing pressure over the decades due to their value and the fluctuating catch rate of the small pelagic could lead to a possible overexploitation of the resource.

The landings of demersal species have risen over the decades by both industrial and semi-industrial fleets in operation, mainly by bottom trawling (Figure 1). Nevertheless, the artisanal sector accounts for more landings of demersal species than other fleets combined. This could be attributed to the inability to undertake bottom trawl fishing due to the narrowness of Ghana's continental shelf and the rocky nature of a sizeable part; beyond 75m deep the seabed is rocky except in few places (e.g. off Axim-Half Assini, Western Region) where bottom trawling is rarely done below 80 meters (Figure 2).

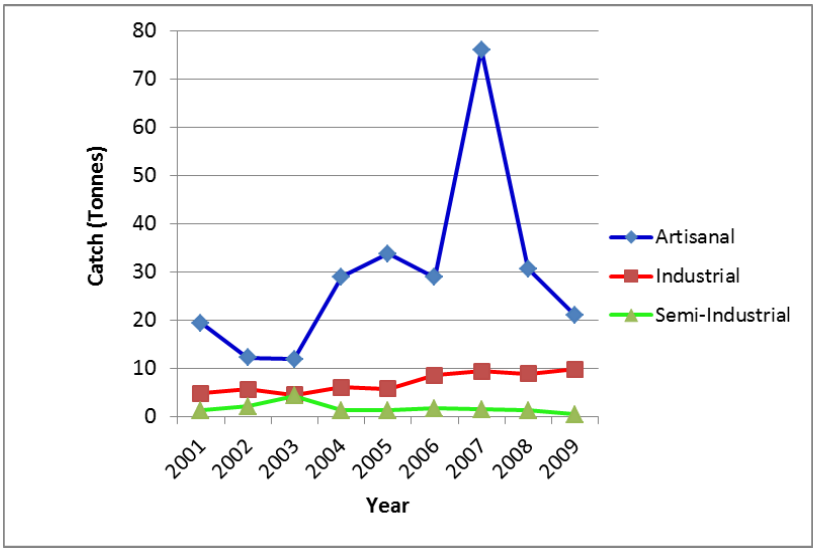


Figure 1: Landings of demersal catches by the various fishing fleets in Ghana (2000-2009) (Marine Fisheries Research Division (MFRD).

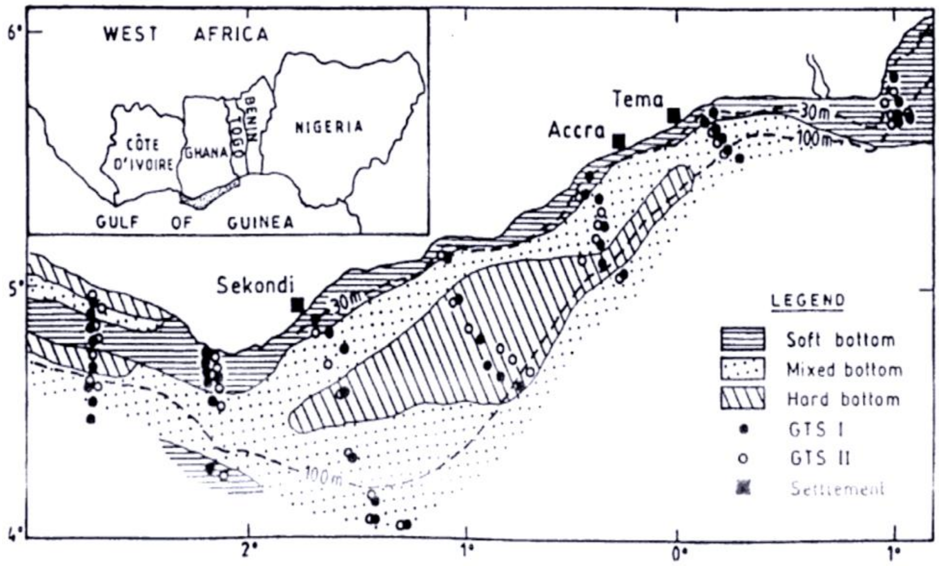


Figure 2: The coast of Ghana showing distribution of bottom sediments and location of hauls in Guinean Trawling Survey (GTS) (Koranteng 2001).

Majority of demersal species are landed by the artisanal fisheries (77%) contributed about 75% of total landings of Sparids over the past decade (Figure 3)

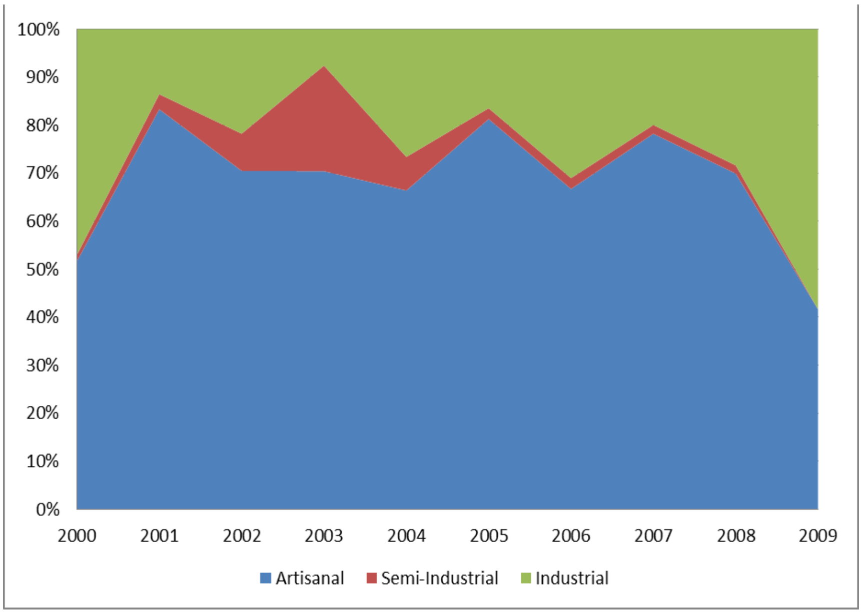


Figure 3: Landings of Sparids by the various fishing fleets in Ghana (2000-2009) (MFRD).

Landings of Sparids over the years by the artisanal sector are very important for the population of coastal communities in Ghana and this study examines the available data on Sparids. This will lead to a better understanding of the quality and weaknesses of the data. The work may contribute to increased knowledge of stock status of the species and subsequently feed into management measures for better utilization of the resource.

1.2 Objective of study

The aim of this study was to explore catch trends in landings of Sparids (Seabreams) by the Ghana artisanal sector. Data covering over 10 years were analyzed with the primary objective of looking at intra annual variation in landings and catch rates, in order to explore the present state and even the continued sustainability of the fishery. Plausible methods for managing the fishery will also be explored.

2 MARINE FISHERIES IN GHANA

Ghana is a tropical coastal country located in the western economical zone of Africa. It is bounded in the east, west, north and south by Togo, Cote d'Ivoire, Bukina Faso and the Gulf of Guinea (Atlantic Ocean) respectively.

Endowed with a coastline of 550 km, the coast of Ghana accommodates four Governmental administrative regions out of a total of ten in the country, viz, Volta, Greater Accra, Central and the Western Regions. The streach of coastline is dotted with several fishing communities that undertake fishing and its related activities as their livelihood.

Ghana has the fifth largest Exclusive Economic Zone (EEZ) in West Africa (218,100 km^2) and a continental shelf area of 24,300 km^2; this varies in width from 20 km off Cape Saint Paul (in the East, Volta Region) to about 90 km between Cape Coast in the Central Region and Takoradi in the Western Region (Figure 3).

The marine fisheries is divided into three sectors, the artisanal, semi-industrial and the industrial fishery.

The fishing sector has a long tradition of artisanal fisheries (Alder *et al*. 2004) supplying the country with more than 70% to the total fish landings. Fish landed are predominantly small pelagics namely, sardinella, chub mackerel, anchovy, horse mackerel etc., and large pelagics predominately tunas and billfishes and coastal demersal species such as Sparids. About 80% of landings from this sector consist of the pelagics with the demersals making up 20%.

The main fishing vessel employed by this sector is the dugout canoe that is either driven by sails or outboard motors. A canoe is identified by the type of gear used and are mainly powered by either an out board motor, sail or paddle. The main gears for targeting demersals are the hook and line, bottom set net and the drift gill net, however, the following gears also lands some demersals due to their mode of operation:

- Ali/Poli/Watsa (APW):
  This is a purse seine made up of three types of net, namely *ali*, *poli* and *watsa*, targeting mostly small pelagics The main body of the *ali* net is a gill net, the *poli* net is constructed with 13 mm mesh.

- Beach seine: this is an encircling net used in the catching of small pelagics.

A total of 334 landing sites are scattered along the entire coastline (Amador *et al*. 2004) directly employing about 124,000 fishers operating with approximately 12,000 canoes.

The artisanal sector is much affected by the natural changes in catch rates of small pelagics specifically the *Sardinella spp*. (Pauly and Koranteng 2002), which is immensely influenced by the strengths of seasonal upwelling (Koranteng 1991). Increase in the fishing effort for these species (Minta 2003) can be attributed to the increase in number of canoes and gears, the efficiency of the gears operated and increased motorization which was 60% of the total number of canoes in 2003 as of 50% in 1992 (Amador *et al.* 2004).

The semi-industrial sector is characterized by the operation of locally built fishing vessels from wood (8-37 m) with in-board engines of up to 400 hp. Gears operated using these vessels are trawl nets and purse seines. Approximately 226 vessels land both pelagic and demersal species depending on their method of fishing, the latter including Sparidae, Lutjanidae and *Balistes carolinensis*. Nevertheless, fishing activities from this sector is declining as most of the fleet is old, and the ban on twin trawling (pair trawling) practiced by the fleet is in effect as a management measure by the Government.

Large offshore vessels are categorized into the industrial sector and are made up of the trawlers, shrimpers and tuna vessels. This is a highly regulated fishery. There are two major ports from which these vessels operate, that is, the Tema Port in the Greater Accra Region and the Takoradi Port, which is in the Western Region of the country. The industrial fishery consists of about 70 steel hulled vessels of length ranging from 30 – 60 m.

This sector is, however, dominated by the tuna fleet operating the pole and line (bait boat) and the purse seine producing 22% of total marine catch. With the exception of the tuna fleet, the other industrial vessels tend to operate in shallow waters (less than 30 m) which is prohibited by the law (MOFA 2002) thereby competing with the other fleets resulting in the destruction of fishing gears especially of the artisanal fishers.

3 ENVIRONMENTAL CONDITIONS INFLUENCING THE MARINE FISHERY

Various oceanographic parameters such as temperature, salinity and oxygen affect the distribution and abundance of fish in an ecosystem. Climatic changes are noted to affect these parameters and as such impact on the migration of species, which significantly affect landings in the catch zones.

Ghana is a tropical country located close to the equator in the Eastern Atlantic Ocean (Gulf of Guniea). This territorial water is in the western section of the Gulf of Guniea that forms a part of the Guinea Current Large Marine Ecosystem (GCLME). This ecosystem experiences two upwelling seasons (Koranteng 1995) that are annually observed off Ghana and Cote d'Ivoire.

The upwellling is influenced by the Guinea current (part of the Canary Current), which flows from Guinea-Bissau in the north of the sub-region to Angola in the South. Upwelling occurs when warmer surface water is replaced by deep cooler water normally high in nutrient thereby resulting in increased primary productivity, which is the base of the food chain in the ocean. The length of time that the sea surface temperature is below 25^oC is an indication of the strength of the upwelling, and this is used to calculate an upwelling index.

According to Quaatey (1996) the major and minor upwelling seasons in Ghana occur between July to September and December to January respectively. These regimes affect fish landings and the species composition. Besides fishing effort, the coastal upwelling is believed to be the most significant factor affecting the marine fishery in Ghana, especially the pelagic species landings (Koranteng 1995).

A low or high index correlates with a higher or lower productivity respectively, which results in higher fish landing for the former situation. From 2001to 2010, the upwelling index was high (24 and above), reaching the highest of approximately 28 in the year 2003. From 2005 to 2008 the index was below 20. Total demersal catches decreased from 2001 to 2003 reaching about 20 tonnes with a related high upwelling index; maximum of about 90 tonnes was noted in 2007 with an upwelling index of about 20. It however decreased to 40 tonnes in 2008 and further to about 30 tonnes in 2009 with a corresponding high upwelling index of about 25 (Figure 4).

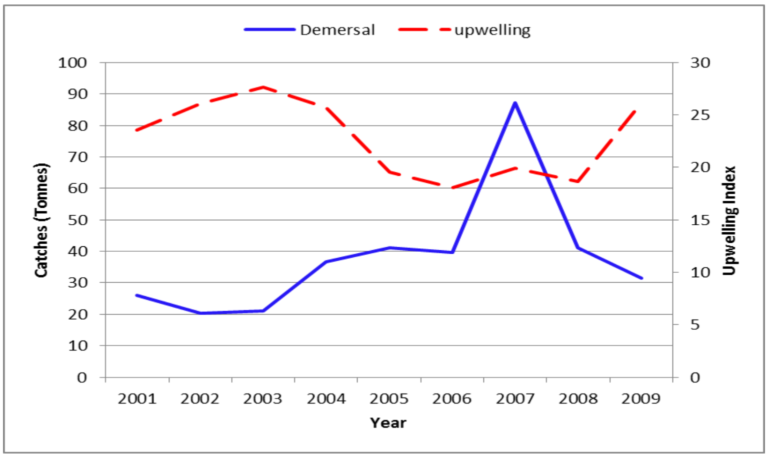


Figure 4: Variations in the annual catches of all demersal species and upwelling index for Ghana (2001-2010) (MFRD).

4 CHARACTERISTICS OF SPARIDS

The family name for all seabreams is Sparidae. They are medium sized fish with variable body colour. They are active fishes and feed on other smaller fin-fish and shellfish (Fishbase 2011). They are almost all demersal with the young generally living in shallower waters than the adults.

In Ghana, seabreams are often caught between 10 m and 100 m depth on hard and coral reef bottoms (Kwesi *et al*. 2005). Table 1 outlines the characteristics of the species exploited in Ghana (Fishbase 2011). These species are distributed in the Eastern Atlantic Ocean with the young ones inhabiting the inshore area and the older ones in the deeper waters.

Table 1: Characteristics of Sparids exploited in Ghana.

Species	Habitat	Depth (meters)	Feed	Distribution	Common Length (cm)
Pagellusbellottii (Red Pandora) Figure 5	Hard and sandy bottoms	10-50	Omnivorous with predominantly carnivorous diet (crustaceans, cephalopods, small fish, amphioxus and worms)	Strait of Gibraltar to Angola, including the south-western Mediterranean and the Canary Islands	25
Sparuscaeruleostictus (Blue spotted seabream) Figure 6	Hard bottoms (rocks and rubble)	30-50	Bivalves, crustaceans and fish	Portugal and Strait of Gibraltar to Angola, including the Mediterranean	50
Dentexangolensis (Angola Dentex)	Bottoms on the continental shelf and slope	15 – 300	Crustaceans, fish, sometimes on molluscs and worms.	Morocco to Angola	25
Dentexfilosus (Pink Dentex) Figure 7	Rocky and rubble bottoms, also on sand around rocks	20-220	Crustaceans, fish and cephalopods	Portugal to Angola; Mediterranean, the Canary and São Tomé-Principe islands	60
Dentexcongoensis (Congo Dentex) Figure 8	Bottoms of continental shelf and upper slope	150-200	Fish, to a lesser extent on tunicates and molluscs	Senegal to Angola	40

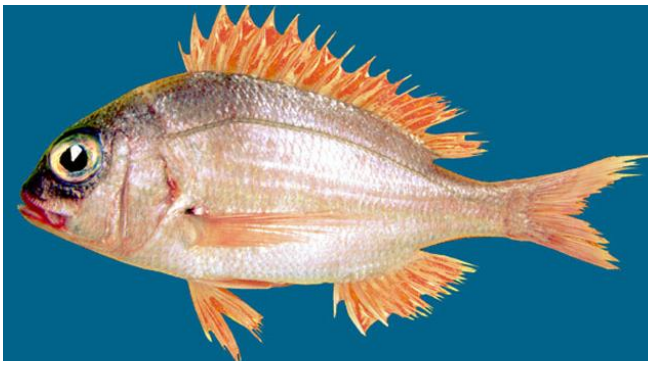


Figure 5: Red Pandora (Pagellus bellottii) (MFRD).

Figure 6*:* Blue spotted seabream (Sparuscaeruleostictus) (MFRD).

Figure 7*:* Pink Dentex (Dentexfilosus) (MFRD).

Figure 8: Congo Dentex (Dentexcongoensis) (MFRD).

5 METHODOLOGY

5.1 Study Area

The study area includes the coastal regions of Ghana, namely the Volta, Greater Accra, Central and Western Regions along the entire 550 km coastline (Figure 8).

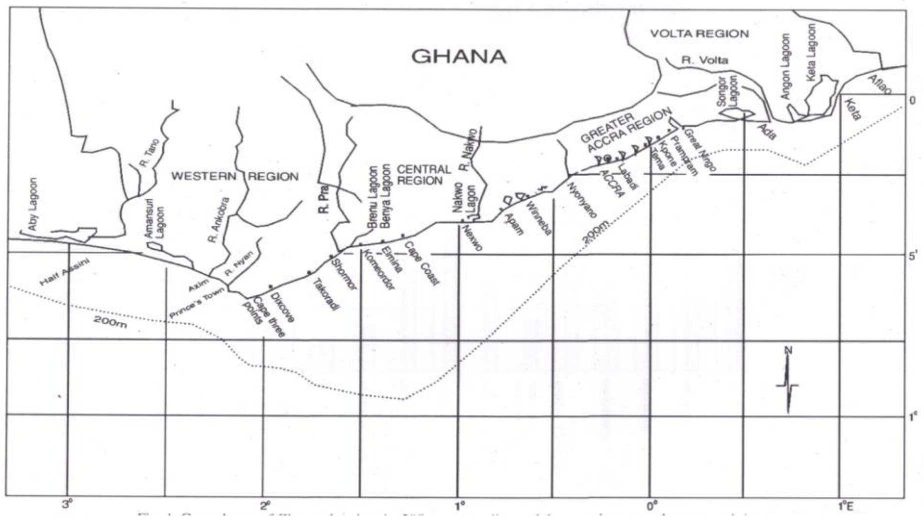


Figure 9: Ghana's coastline showing the study regions (MFRD).

Ghana has an EEZ of 218,100 km^2 and continental shelf area of 24,300 km^2. The shelf varies in width from 20 km off the East (Volta Region) to about 90 km between Cape Coast in the Central Region and Takoradi in the Western Region. A substantial part of the continental shelf is rocky.B eyond 75 m depth the substrate is rocky except off Axim-Half Assini (Western Region).

Approximately 125,000 artisanal fishermen operate from 334 landing sites along the coast (Table 2). Most of the fishers come from the Central Region (44,000) and the Greater Accra Region (35,000).

Table 2: Regional details of artisanal fishery (MFRD – 2004 Canoe Frame Survey).

Region	Canoes	Fishermen	Landing site	Fishing Village
Volta Region (VR)	736	17382	63	29
Greater Accra Region (GR)	2781	35168	68	48
Central Region (CR)	4450	44303	103	43
Western Region (WR)	3246	27366	100	75
Total	11213	124219	334	195

5.2 Data

A ten-year series of catch and effort data were obtained from the Marine Fisheries Research Division (MFRD) of the Fisheries Commission of Ghana and used for this study. This is the only governmental agency mandated by law to collect data for the management of the marine fisheries resource. The data set consisted of monthly catches and effort of all the seabreams landed by the artisanal fishery.

Catch and effort assessment survey is implement with fisheries enumerators at 50 selected landings sites out of the 334 recorded from the last canoe frame survey undertaken in 2004. The enumerators record the weight of landings of active fleets. All vessels are enumerated if they are fewer than 10 at each landing site however, if there are more than 10 active vessels, a random sample is taken. A data quality check is done after which the data are entered and processed in ArtFish software designed by FAO to estimate the total landings. Data is stored in Microsoft Excel after validation.

Effort in the artisanal sector is indicated by the number of days at sea. This varies with respect to the fishing gear being operated ranging from one to five days, if ice is taken to sea in insulated containers to preserve the catch.

5.3 Data analysis

The time series data available was plotted using the R-statistical software and correlations to environmental factors and other available data was explored.

Length frequency data of the Sparids were obtained from the Fridjof Nansen Survey report of 2005 conducted in the Gulf of Guinea. This included length distributions from previous surveys also for the years 1999, 2000, 2002 and 2004, which were plotted using R.

6 RESULTS

6.1 Variation of total catch and Catch per Unit Effort (CPUE) of species

Generally, there were fluctuations in the catches and CPUE of all the species over the years (Figure 10). All the species are experiencing a downward trend in catches from 2005 to 2010.

Angola Dentex showed an increase in landings between the years 2003 and 2006 with catches rising to 3000 tonnes from below 1000 tonnes. A corresponding increase in CPUE also occured in the same period. This however, decreased from 80 to about 30 between 2007 and 2008 but then increased to 90 in 2010 whiles catches continued to decrease.

Catches of Congo Dentex decreased from more than 800 tonnes to less than 200 tonnes from 2005 to 2010 respectively. The CPUE seemed to alternate in each year within the same period but the most significant decrease occurred between 2007 and 2009.

The Bluespotted Seabream showed alternate increase and decrease in catches and its corresponding CPUE with a cycle of 3 to 5 years. The highest catch of about 4000 tonnes occured in 2004 whiles the CPUE of 30 was in 2008. All the same, 2010 recorded the lowest catch less than 1000 tonnes and a CPUE of less than 10 in 2003.

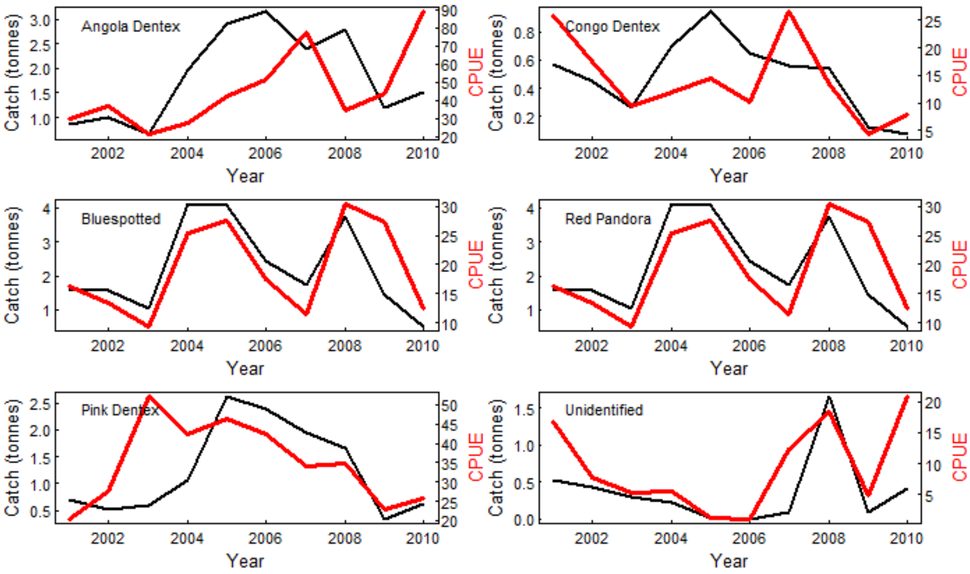


Figure 10: Variations in Catch and CPUE of landed Sparids.

Red Pandora catches increased from 2001 to its peak in 2005 of 7000 tonnes but declined to about 1000 tonnes in 2009. CPUE experienced rise in the early part of the period and significantly increased in 2007 to more than 10 with a sharp decrease to 30 in the following year.

The highest catch (2500 tonnes) for Pink Dentex was noted in 2005 after a steady increase in the previous years whiles CPUE also increased accordingly recording its highest (50) in 2003. However, the subsequent years exhibited a decline in both parameters recording the lowest in 2009 of below 500 tonnes and 20 respectively.

Catches and CPUE of the unidentified group of Sparids decreased from 500 tonnes in 2001 to 2006. These were noted to upsurge to about 1500 tonnes and 20 respectively in 2008. This category encompasses all species that are not properly identified during landing.

6.2 Regional catches of Sparids

Total catches of Sparids by all gears by the various regions is illustrated in Figure 11 below. It is observed that all regions with exception of the Volta region displayed substaintial increase in catches of Sparids between 2003 and 2005. This steadily decreased in the subsequent years.

The Central region recorded the highest landing of about 8000 tonnes of Sparids accompanied by the Western and Greater Accra regions respectively. Lowest catches for these regions occurred in 2003 and 2009 of 2000 tonnes and below. Catches of the Volta region were insignificant compared to the other regions within the period.

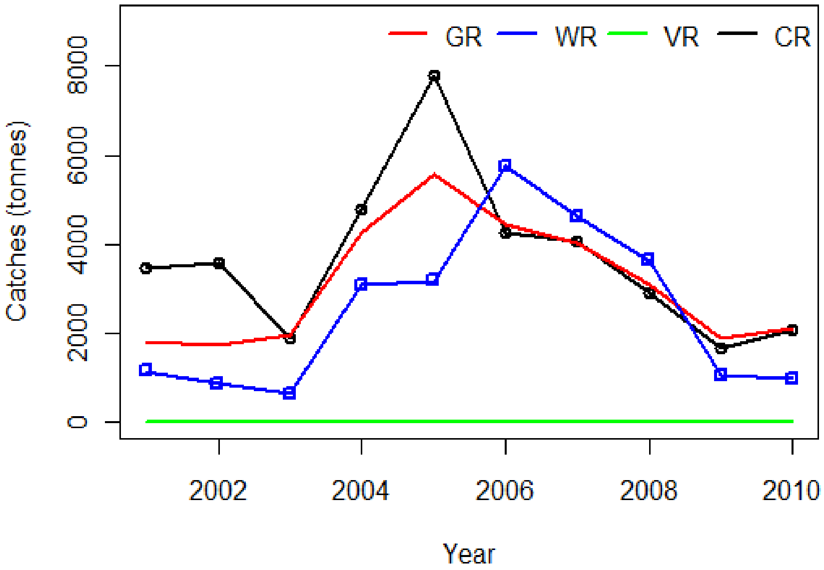


Figure 11: Total Catches of all Sparids by Regions.

6.2.1 Regional catches of species

The individual species of Sparids landed in all the four regions is illustrated in Figure 12. Catches of the various species in the Volta Region were insignificant. Greater Accra region displayed a range of 1000 to 2000 tonnes of highest catch of Bluespotted Seabream, Angola Dentex, Red Pandora and Pink Dentex between 2003 and 2009. This period shows a gradual decline in the catches with time.

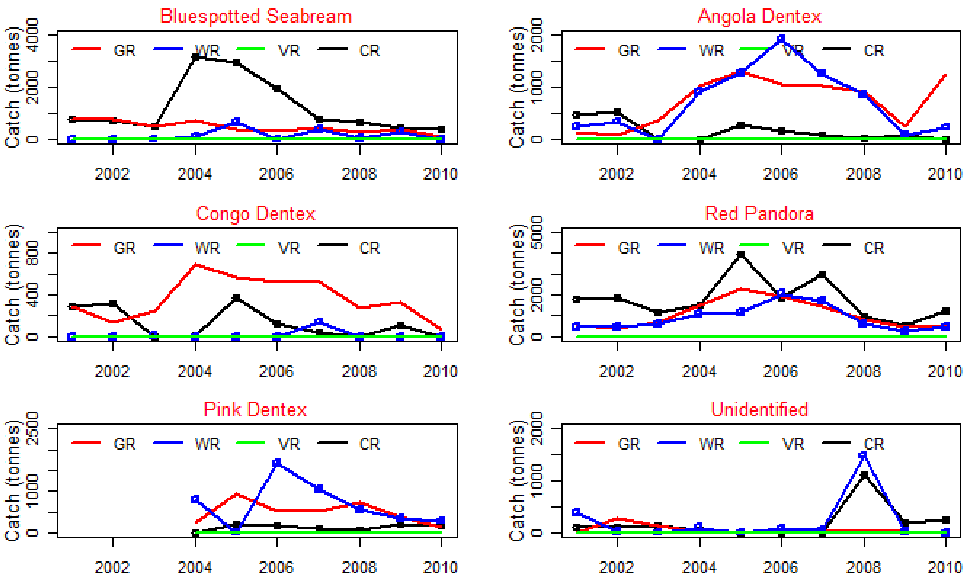


Figure 12: Annual Catches of Species by regions.

The Central region recorded very high catches of Bluespotted Seabream and Red Pandora with catches at about 3000 tonnes in 2004 and 2005 respectively. Angola Dentex and Congo Dentex have similar decreasing trend of landings within the period with high catch in 2002 and 2005. Catches of Pink Dentex seemed stable where the lowest catch was noted in 2004. Species that were not unidentifable from the region increased notably to from zero to about 1000 tonnes in 2008.

Catches of Bluespotted Seabream in the Western region declined from 2001 to 2004. and alternately increase and decrease from 2005 to 2010. In 2006,catches of Angola Dentex, Red Pandora and Pink Dentex peaked at approximately 2000 tonnes. Low catches were noted in 2003 and 2009 for these species. Catches of Congo Dentex was stable from 2001 to 2006 and peaked in 2007 at about 500 tonnes.

Landings of unidentified species increased significantly in the Central and Western regions, 2008 of about 1500 tonnes after recording steady catches from 2002 to 2006.

6.3 Catches of Sparids by gear

Demersal targeting gears (bottom set net and hook and line) recorded the highest catches of Sparids from 2001 to 2006 (Figure 13). There was an increase in catches of the Hook and Line from 2003 to 2005 and decrease in 2006 for the Greater Accra, Central and Western regions. This increased in 2007 and dropped in the successive years except Central region that noticed a continuous decrease in 2008 and subsequently increasing in 2008.

Landings by the bottom set net and Ali/Poli/Watsa (APW) were significant in the Central and Western regions. Catches of the former gear in the Central region alternated (rose and fell) from 2002 to 2004; the highest catch of about 800 tonnes was noted in 2005 where it steadily declined in the subsequent year to 2009. The Western region had similar trend of alternating rise and fall of catches with a two-year interval from 2002 to 2006; this peaked to about 1500 tonnes in 2008 and substantially decreasing in 2009 and 2010.

Figure 13: Regional annual catches of all Sparids by gear.

APW also considerably landed some species for the Central and Western regions with the former region landing about 2000 tonnes in 2004 and 2007; the latter region noticed about 4000 tonnes of catches in 2006.

6.4 Seasonal variations in Catch and CPUE

Mean monthly catch rates and CPUE of Red Pandora were approximately constant from December to June (Figure 14). There was a drop in these matrices in June to August and then an increase in October to November.

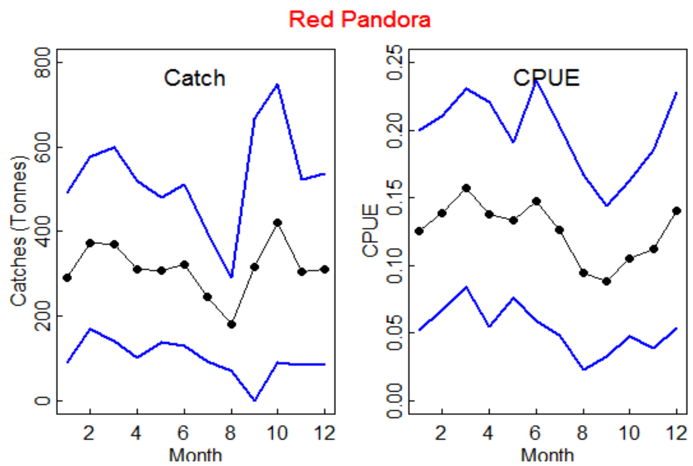


Figure 14: Red Pandora- Mean monthly catches and CPUE (dotted line) from 2001 to 2010 and 1 standard deviation (sd) (blue lines). Negative values for sd were rounded up to zero.

Mean monthly catch rates of Bluespotted Seabream were almost stable over the year except for October (Figure 15). Catches were low from June to Sept (major upwelling) and noticably increasing to the highest peak of about 250 tonnes in October, this declined in November and December.

The corresponding mean CPUE (Figure 15) showed a decline from February to April and steadily increased in the subsequent months to June. There was a decrease in July and September with October and December recording the highest (0.05) and lowest (less than 0.025) CPUE.

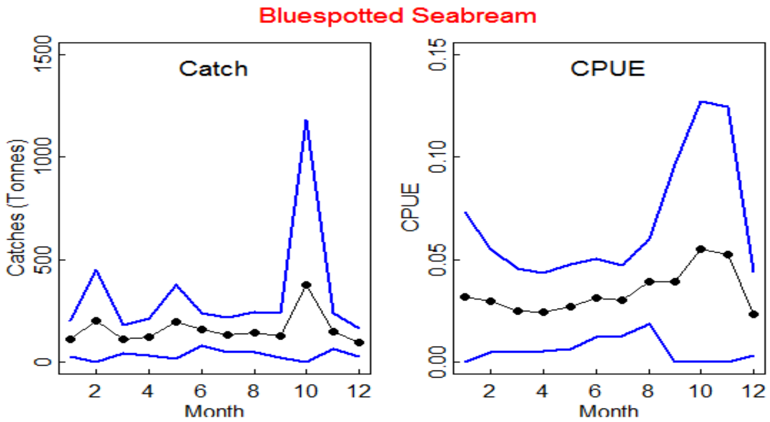


Figure 15: Bluespotted Seabream - Mean monthly catches and CPUE (dotted line) from 2001 to 2010 and 1 standard deviation (blue lines). Negative values for sd were rounded up to zero.

Angola Dentex showed variations in the mean catch and CPUE over the period (Figure 16). A declining trend from February to September is observed with the lowest catch in September (≈ 100 tonnes) and increasing to the highest peak in November (≈ 200 tonnes).

The CPUE decreased from January to the lowest in April (less than 0.05), this increased steadily to October and reaching the highest peak in November (0.1) and further decreasing in December. It is also noted that the lowest mean catch in September does not correspond to the lowest CPUE (April).

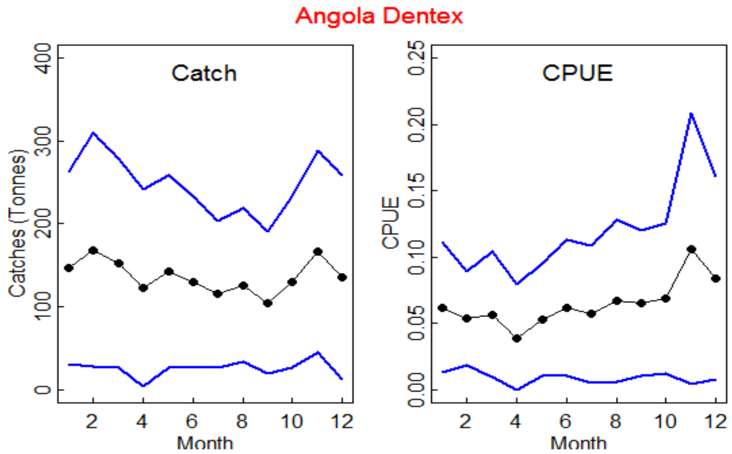


Figure 16: Angola Dentex - Mean monthly catches and CPUE (dotted line) from 2001 to 2010 and 1 standard deviation (blue lines). Negative values for sd were rounded up to zero.

Mean monthly catch rates of Pink Dentex were at a peak in March of about 150 tonnes (Figure 17) with a related CPUE of 0.1. Landings decreased in April with a CPUE with the same recorded value of 0.1 in March. A further decrease of the CPUE to approximately 0.03 lowered the catches to about 50 tonnes in May. Increase in the

CPUE in June of about 0.03 increased the catches in the month by approximately 50% and further with about 25 tonnes with the same CPUE in July. An additional increase in CPUE responded with a decrease in catch in August.

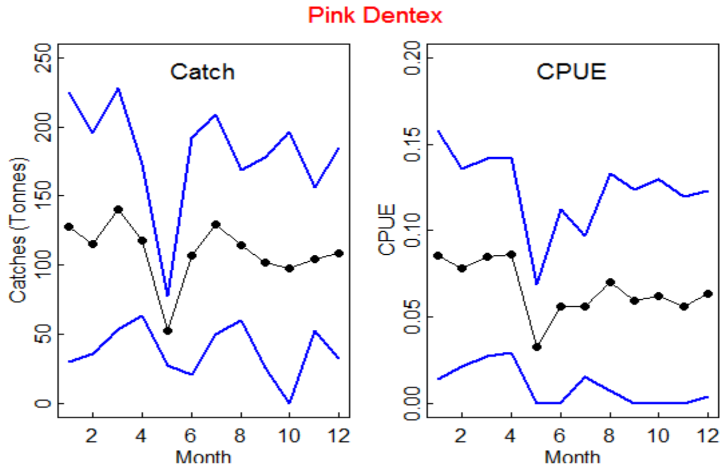


Figure 17: Pink Dentex - Mean monthly catches and CPUE (dotted line) from 2001 to 2010 and 1 standard deviation (blue lines). Negative values for sd were rounded up to zero.

Mean monthly catch rates of Congo Dentex varied substantially from month to month (Figure 18). The major upwelling season (December – January) coincided with high catches (approximately 51 tonnes). Landings were however low in the minor upwelling season (July –September); the lowest and highest mean catches were noted in June and October respectively.

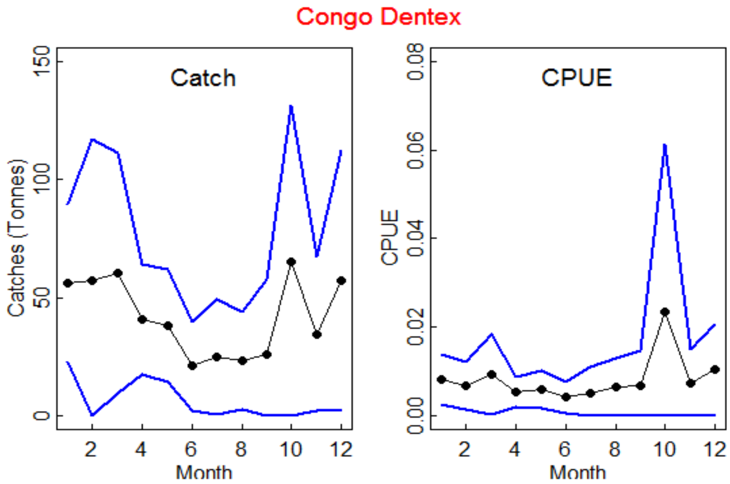


Figure 18: Congo Dentex - Mean monthly catches and CPUE (dotted line) from 2001 to 2010 and 1 standard deviation (blue lines). Negative values for sd were rounded up to zero.

The monthly pattern of variation of the CPUE of Congo Dentex observed peaks in March and October of about 0.01 and 0.02 respectively. It was however almost steady from April to September with the lowest occurring in June which coincided with lowest catch.

The category of unidentified seabream showed great variations in mean monthly catch rates and CPUE. Due to the fact that this category may be composed of many species with physiological features marred can be derived from Figure 19.

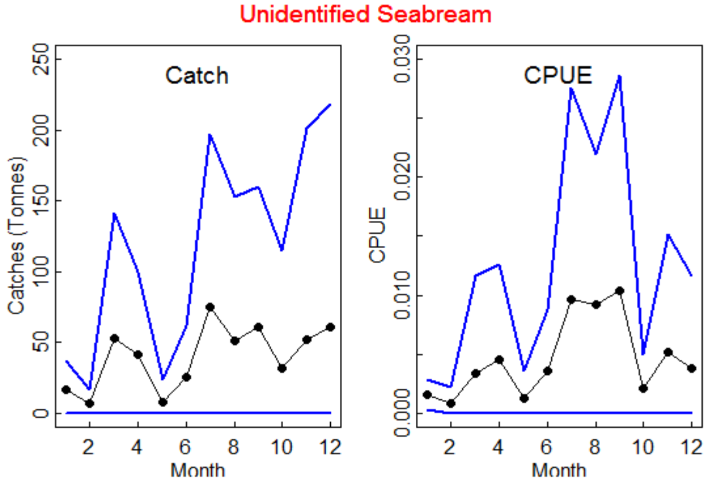


Figure 19: Unidentified Seabream - Mean monthly catches and CPUE (dotted line) from 2001 to 2010 and 1 standard deviation (blue lines). Negative values for sd were rounded up to zero.

6.5 Species composition

Illustrations in Figure 20 shows the monthly species compostion of the landings of the various species of Sparids over the decade (2001 – 2010). The major upwelling season (July to September) and minor upwelling season (December to January) are indicated by dotted and straight lines respectively.

Compostion of Red Pandora was stable before and after the major upwelling season of about 40% of all catches. Bluespotted Seabream showed distinct variations in the percentage of monthly composition; a cylce of high compostion is observed in February, June, August and October.

The Angola Dentex showed consistency in throughout the months except in after the major upwelling season where it declined. The composition of Pink Dentex reduced in May and October while it increased within this period (May to October) and continued to increase from November to April.

The compositon of Congo Dentex declined for major parts of the months. High compositons are noted before and after the major upwelling season. June to October (within the major upwelling season) recorded significant quantities of the unidentified category of seabreams.

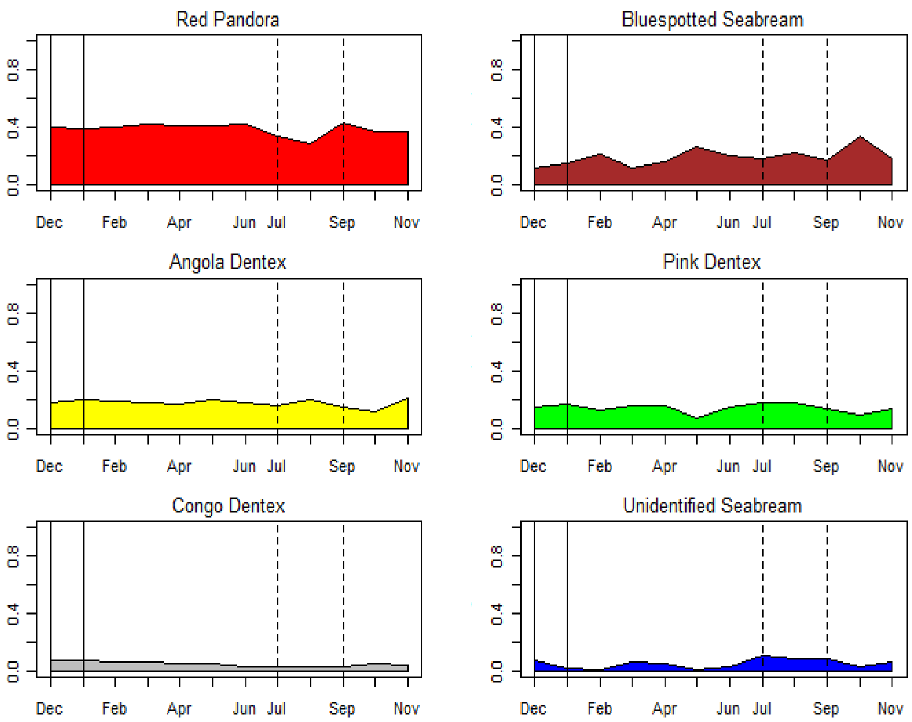


Figure 20: Annual mean (2001-2010) species composition of all Sparids during upwelling.

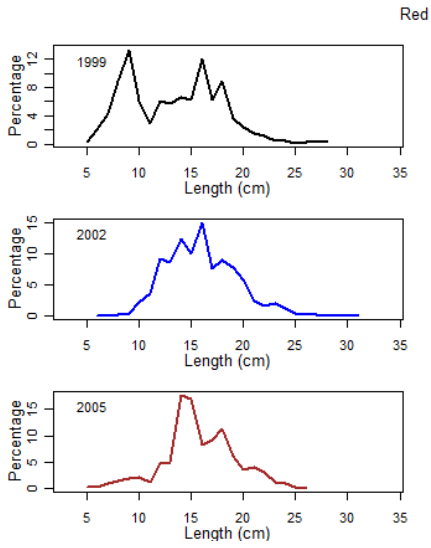
6.6 Length frequency distribution of sparid (trawel survey)

Recuritment of Red Pandora was noted in 1999 and 2000; this was significant in 1999 (Figure 21a). Much of recuritment is not observed in the subsequent years. The dominate length range noted was between 10 cm and 25 cm.

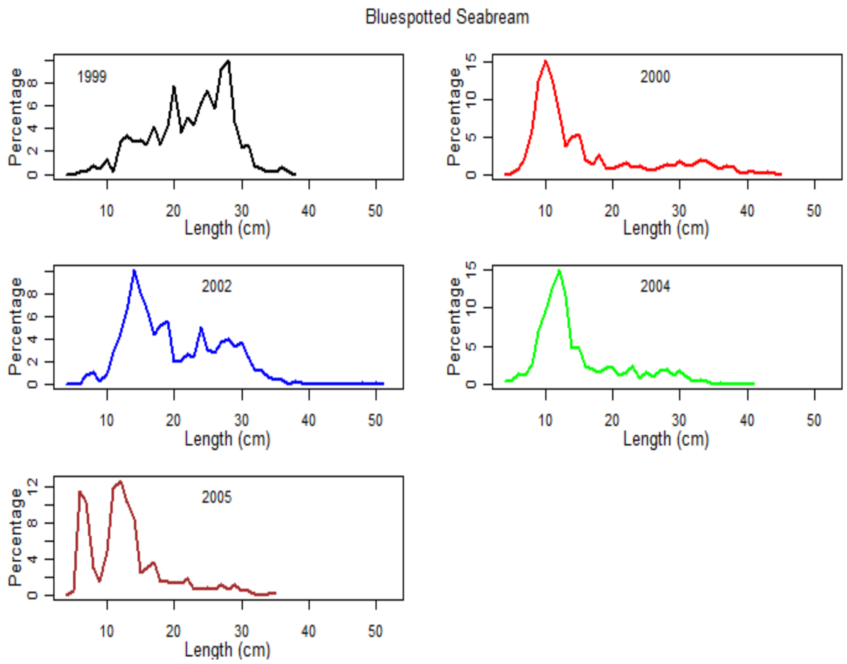
The overall size range for Bluespotted Seabream (Figure 21b) recorded over the years examined was 5cm to 50cm. Larger sizes (20 cm and above) were hardly observed in the sample in 2000, 2004 and 2005. The high deviations of the mean length were observed the years in 2000 and 2002 (Table 3).

Table 3: Mean size and Standard deviation (SD) of length frequencies from Dr. Fridjof Nansen trawl survey.

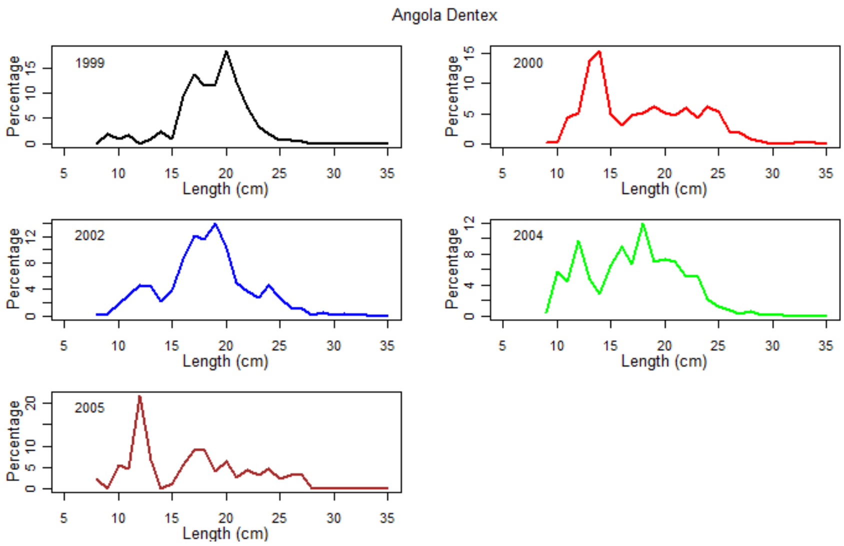
Year	**Red Pandora**		**BluespottedSeabream**		**Angola Dentex**		**Congo Dentex**	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
1999	13.4	4.38	22.5	5.92	18.7	3.69	12.2	2.63
2000	14.5	4.06	15.5	8.56	17.8	5.20	12.5	3.59
2002	15.9	3.27	20.0	7.00	18.2	4.49	14.9	2.61
2004	15.8	3.39	14.9	6.49	17.2	4.75	12.7	2.93
2005	15.8	3.33	12.9	5.83	16.7	5.44	11.3	2.67


Red Pandora
1999
2000
2002
2004
2005
Percentage
Length (cm)

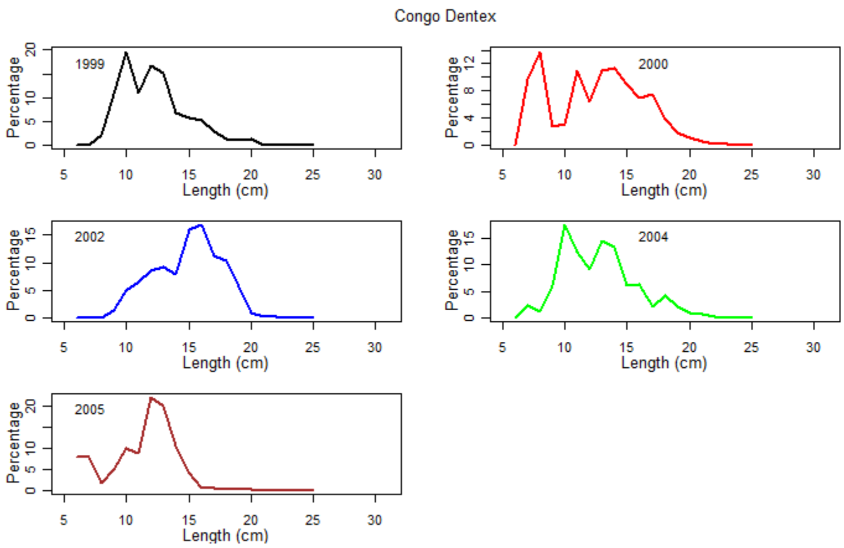
a)


Bluespotted Seabream
1999
2000
2002
2004
2005
Percentage
Length (cm)

b)



c)



d)

Figure 21: Length frequency distributions of Sparids from trawl surveys for the years 1999, 2000, 2002, 2004 and 2005.

Samples of Angola Dentex indicated recruitment in all the years except in 1999, which showed little or no recruitment (Figure 21c). There was not much variation in the mean length of the species sampled (Table 3), notably, a much wider variation in the mean length was observed in 2005.

Indications of recruitment of Congo Dentex were observed in 1999 and 2000, the other years were not clear (Figure 21d). Much larger fish (15cm and above) were observed in all years except 2005. Variations in the mean length for all years were fairly constant except in 2002 (Table 3).

7 DISCUSSION

7.1 Status of the artisanal Sparid fishery

Landings of all the species show a general decline over the period. Total catch of Red Pandora decreased from its peak of 7000 tonnes in 2005 to about 1000 tonnes in 2009. A bi-modal catch was observed in 2005 and 2007 with CPUE reflecting the same pattern. However, the CPUE in 2005 was lower (40) than in 2007 (100) of which the lower CPUE landed the highest weight of Red Pandora over time. A similar bi-modal pattern was observed for Congo Dentex for the same years (Figure 9). This trend can be a result of the high catchability of the gear to both Red Pandora and Congo Dentex as the variation patterns of the catch and CPUE for both species are identical.

A decline in CPUE from 2005 to 2009 of the Pink Dentex landed more catches than the previous year (2001-2004) that recorded an increase in CPUE (from 20 to 50). This decline indicates a possible decline in the stock of Pink Dentex available for exploitation by the artisanal fishery. There is also the possiblilty of recuitment of the species into the fishery between 2001 to 2004 where the size class were too small to encounter the fishing gear.

Angola Dentex experienced an increase in CPUE from 2003 to 2007 with corresponding increase in catch. Subsequent years however recorded lower catches with increase of CPUE of which 2009 and 2010 observed very low catch. This may indicate a decrease in stock size of the species in recent times.

The annual variation in CPUE of the Bluespotted Seabream had a substaintial effect on the landings. Both variables recorded the same trend over the years. Catches of the unidentified category of seabreams increased in 2008. This is likely to be a result of the inability of field recorders to properly identify the species landed due to improper storage of fish at sea and also a considerable landing of other species of Sparids that is not coded for sampling.

7.2 Distribution of Sparids

The Sparids are distributed towards the western part of the country. The Central, Western and Greater Accra regions catch the most weights of the species; catches of Volta region is insignifant to total landings of Sparids in Ghana. This is inferred to the topography of the continental shelf which is narrow at the Volta region (from 20km) off to about 90 km between Cape Coast in the Central region and Takoradi in the Western region (Figure 2).

Generally there is a decline in landings in all three regions from 2006 to 2010 (Figure 11). Landings from the Central region is the highest of which the Western and Greater Accra regions follow respectively. This is as a result of the high number of canoes operating in the Central region (Table 2).

Red Pandora catches are highest in the Central region and evenly distributed between Greater Accra and Western regions. Though much data were not available, Pink Dentex was observed to be more abundant in the catches of Western and the Greater Accra regions.

Among the demersal targeting gears in operation, the hook and line catch most of the Sparids in Ghana. It is noted that this gear plays significant role in catches from the Western and Greater Accra regions where as the bottom set net lands most catches of Sparids in the Central region (Figure 12).

Catches of Ali/Poli/Watsa (APW) was significant from 2003 to 2010 for the Central and Western regions. This however influenced catches of Angola Dentex and Pink Dentex from the Western region. This significant increase in landings by APW can be related to the possible change of mesh sizes of net as such these landed Sparids are juveniles that inhabit the shallow waters during thier life cycle. There is however no data to conclude on the size of Sparids landed by the APW and also information of the possible change in the mesh size is not available since the last canoe survey was conducted in 2004.

The unidentified category of Sparids was mostly observed from the Western and Central regions. This category encompasses fish that could not be properly identified or not in the list of Sparids in the database. Further examination of this category needs to be undertaken to curtail increases in subsequent years.

7.3 Seasonal variations

Most species were landed before and after the upwelling seasons. Effort within the major upwelling season was low or steady implying that fishing pressure was on the small pelagics as it was the period that catches of small pelagics increase.

It is clear that Red Pandora, Bluespotted Seabream, Angola Dentex and Pink Pandora are abundant in the landings due to the natural distribution of habitat by depth (Table 1) and the shallow depth that the artisanal gears operate. From Figure 20 landings of these species generally decreased in the major upwelling season (July –September) and increased in the minor upwelling season (December- January).

7.4 Size composition from Trawl survey

Indications of a size range of 10 cm to 25 cm of the various Sparids are available to the fishery from the trawl survey conducted over the years. Red Pandora observed over the years a steady significant catches of between the range of 10 cm and 20 cm (Figure 21a). The indication of recuritment was not observed in latter years after a major indication of fish size of less than 10 cm making up about 12% the total sample in 1999.

Large fishes (20 cm and above) of Bluespotted seabream were in 2000, 2004 and 2005. Recrutiments (small fish) were significantly observed for the Angola Dentex except for 1999. Though large sizes of Congo Dentex were hardly observed in the samples over time there is decrease in large sized fish over time. The low percentage of large fish composition in samples can be the result of inability of trawling deeper due to the topography of the country’s continental shelf.

It is however difficult to compare this information with the artisanal fishery as there are no length frequeny data avaliable to analyze and draw conclusions.

8 CONCLUSION AND RECOMENDATION

This study examines the seasonal trend and abundance of Sparids in the artisanal fishery in Ghana. In general, there is a decline in catches of Sparids. It was noted that catches of the major Sparids declined during the upwelling seasons and by-catch of non-Sparid targeting gears increased especially for the Ali/Poli/Watsa (APW) gear in recent times.

It is important to improve the monitoring of the artisanal fishery to ensure that fishers comply with management regulations (mesh size) to ensure the sustainability of the stock. Much more biological information of Sparids in Ghanaian waters should be obtained and updated on existing databases such as the Fishbase.

Drawbacks in the data collection and storage caused some difficulties in using the data to assess the fishery. The following are recommendations that will aid further examination of the fishery:

- It is important to add more information collected from the fishery during sampling of the fish such as the length frequency.

- It is also recommended that a canoe frame survey be conducted early to update the existing data and the collection of demographic and socio-economic information.

- Implementation of a data storage system by the Marine Fisheries Research Division (MFRD) is vital to enable more information to be readily available for stock assessments.

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