Fish Stock Status of the Middle Reach of the Sombreiro River of the Niger Delta Basin, Nigeria

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ABSTRACT

A twenty four week fish survey was conducted to determine the status of the fish species in the middle reach of the Sombreiro River in Rivers State. The results revealed a composition of 31 species from 20 families, from a total fish catch of 40,509. The Cluepeid *Sardinella maderensis* was the most prominent species followed by the Mugilidae- *Liza falcipinnis and Mugil cephalus*. There were 13 species that were least, including the *Illisha africana*. The abundance score showed that some species like the *Sardinella maderensis* were dominant(D), some Abundant(A), some Few, some Common (C), others like the *Lophius. vailanti* were Rare (R). The abundance also varied significantly during the period of the study, indicating a seasonal abundance with the 1st to 6th weeks having higher abundance for most species, and then a drop in abundance from the 7th week, when some species became unavailable *(Dasyatis margarita),* to 24th week when many decreased in abundance. Interestingly, some species increased in number *(Pomadasys jubelini , Arius lasticutatus)* and some others like *Seratherodon melanotheron* remained stable. The analysis of variance (ANOVA, $P < 0.05$) showed that there was significant difference between weeks of the study with the 1st and the 2nd weeks being highly significant, and clusters of weeks signifying the dry season significantly different from the weeks of the rainy season.

Keywords: fish species abundance, fish species composition, middle reach of sombreiro river.

Classification: FOR Code: 070499

Language: English

London
Journals Press

LJP Copyright ID: 824565
ISBN 10: 1537586327
ISBN 13: 978-1537586328

London Journal of Research in Science: Natural and Formal

Volume 18 | Issue 1 | Compilation 1.0

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I. ABSTRACT

A twenty four week fish survey was conducted to determine the status of the fish species in the middle reach of the Sombreiro River in Rivers State. The results revealed a composition of 31 species from 20 families, from a total fish catch of 40,509. The Cluepeid *Sardinella maderensis* was the most prominent species followed by the Mugilidae- *Liza falcipinnis and Mugil cephalus.* There were 13 species that were least, including the *Illisha africana*. The abundance score showed that some species like the *Sardinella maderensis* were dominant(D), some Abundant(A), some Few, some Common (C), others like the *Lophius. vailanti* were Rare (R). The abundance also varied significantly during the period of the study, indicating a seasonal abundance with the 1^{st} to 6^{th} weeks having higher abundance for most species, and then a drop in abundance from the 7^{th} week, when some species became unavailable *(Dasyatis margarita),* to 24^{th} week when many decreased in abundance. Interestingly, some species increased in number *(Pomadasys jubelini , Arius lasticutatus)* and some others like *Seratherodon melanotheron* remained stable. The analysis of variance (ANOVA, $P < 0.05$) showed that there was significant difference between weeks of the study with the 1^{st} and the 2^{nd} weeks being highly significant, and clusters of weeks signifying the dry season significantly different from the weeks of the rainy season.

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II. INTRODUCTION

Fish are rich sources of protein, essential fatty acids, vitamins and minerals. Fagade (1992), reported that fish flesh is about the best source of animal protein, better digested than beef and poultry, and it contains a good quality and quantity of mineral salts. Also, fish oil is a poly-unsaturated fatty acids with anti-cholesterol factor. He concluded that regular consumption of fish is beneficial to human body. Fish from capture fishery is on the decline in Nigeria due to over exploitation and inadequate management of her coastal waters. For sustainability of fisheries resources, assessment and documentation of the status of the fish stock (species composition and abundance of fish fauna) is pertinent.

The Niger delta region is one of the most-biodiverse center of the world that contain significant values of mangroves and diverse fish species in the world. The Sombriero River system is one of the most important river systems in the Niger Delta Basin, providing nursery and breeding grounds for a large variety of fish species. The middle part of the Sombriero River is located between the Degema and Akuku-Toru Local Government Areas of Rivers State. The communities around this river depend on it for their protein source and livelihoods as they are primarily fish food consumers and fishers.

So many researchers have carried out several research surveys to assess the fish stock status in several rivers in the Niger Delta Basin of Nigeria. Alfred-Ockiya (1995) observed 28 families and 41 species in Kolo creek, Rivers State; Chindah and Osuamkpe (1997) studied the fish assemblage of the Lower Bonny River of the Niger Delta with its

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adjourning creeks and observed 25 families consisting of 57 species. Sikoki *et al.* (1998) observed a total of 24 species belonging to 15 families in the Lower Nun River using a fleet of 9 gill nets that ranged from 3/4"-7" mesh sizes. Ezekiel *et al (2002)* in the Odhiokwu-Ekpeye local fish ponds and floods plains had 25 species of fishes from 16 families. Ibim *et al.* (2016) reported a total of 61 species, belonging to 54 genera, 41 families and 15 orders, from the Lower and Upper New Calabar River.

In spite of the importance of the Middle Reach of the Sombriero River to the communities around it, there is a scarcity of information on the Fish Stock Status. However, Fishing in the Middle reach of the Sombriero River is a very important occupation as the indigenous people around the river are primarily fishers and fish consumers. Fishing is intense and carried out indiscriminately with various traditional and modern fishing gears. Also, due to speedy industrialization and other major human activities around, the river is fast becoming degraded. This has resulted in the reduction in fish catch and the gradual loss of certain species well known to the river system as reported by the fishers around the Middle Reaches of the Sombreiro River (Pers. Comm).

It is of great importance to adequately manage the fish and the fishery resource of this section of the river in order to enhance the sustainability of the fisheries and Fish food security.

III. MATERIALS AND METHODS

3.1 Study Area

The study was carried out at the middle reach of the Sombrero River. Three locations in the river are located as sample Sites. The locations sampled are Degema (Latitude 4°45'27.63"N and Longitude 6°45'31.18"E), Krakrama (Latitude 4°44'56.33"N and Longitude 6°46'42.57"E) and Abonnema (Latitude 4°42'55.56"N and Longitude 6°46'24.29"E). The Sombreiro River is located east of the Orashi River and originates from swamps in the Oguta-Ebocha zone. It has its source from the Niger River, runs downwards into the Southern tip of the Niger Delta basin and empties into the Atlantic ocean. The Middle Reach of the Sombriero River is brackish and appears turbid during the raining season.. The vegetation of this study area is made up of red and white mangroves (*Rhizophora mangle* and *Avicenia* spp., respectively), Nypa palm (*Nypa fruticans*), *Ipomoea aquatica, Nymphea lotus, Mimosa pigra, Eichhornia natans,* among others. This river is economically important as numerous human and economic activities take place within the study area. The area experiences two seasons: wet and dry seasons. The wet or rainy season occur between March to October with annual rainfall between 2,000 and 3,000mm per year. The dry season lasts from October to February with occasional rainfall (Ezekiel, 2002).

Experimental Procedure Sampling, Preservation and identification of fish samples

These sites were sampled for fish by a fisher twice weekly using various gear type (nets of different mesh-size and traps). The gear and mesh sizes used were 10—15mm cast net, 15mm drift net and 5mm seine net. However drift nets were used at nights only because of vessels plying the busy river system in the day time. Basket traps were also used in narrow and shallow sections of the River.

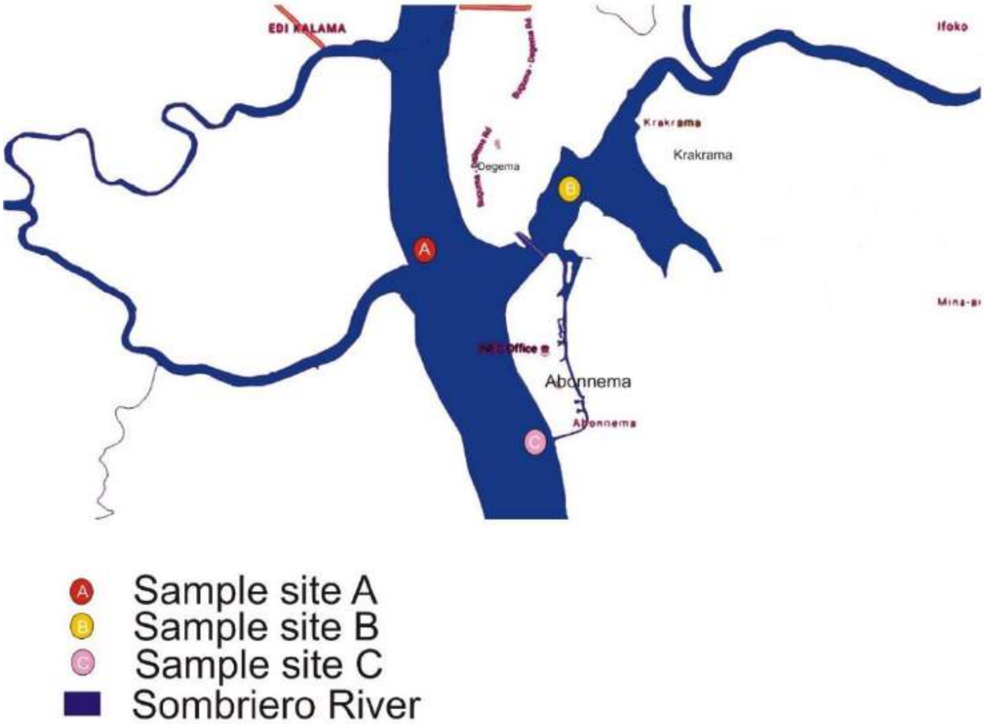

Figure 1: Map of the study area showing sampling locations.

Fish were collected from the local fishers as the catch was landed. The total count was estimated and the fish sorted into species. Fish samples were then preserved and taken to the laboratory in a plastic bucket containing 4% formalin for further identification to the level of species.

3.2 Physico-chemical Parameter Determination

The water quality parameters (dissolved oxygen, temperature, pH, conductivity) were monitored biweekly. The sampling lasted for 24 weeks (6 months). Temperature: Water temperature was measured using mercury bulb thermometer inserted in the water for about three (3) minutes and the temperature reading was recorded. pH of collected water sample was measured using a pH metre (P. IIIATC Pen Type pH Meter,). Dissolved Oxygen: This was measured from water samples in the laboratory using a Millwaki dissolved oxygen meter. Salinity of the water samples were measured using a salinometer (name, as above for pH) to read off the salinity which is read in parts per thousand (ppt).

3.3 Fish Composition Determination

Fish composition was determined by estimating the Total Count (number) of landed fishes from the study area, and snaps shots taken to capture their physical features Secondly, fish samples were further identified to the level of species, using standard identification keys, book and online guides such as (Wheeler, 1994; (Idodo-Umeh, 2003), (Sikoki and Francis, 2007) and FishBase (Froese and Pauly, 2010) and Ibim and Francis (2012).

3.4 Fish Species Abundance Determination

Abundance was determined by the relative abundance method and the relative abundance score of the species was estimated following the criteria of (Allison, 1997) as 1-50 = Rare (R), 51-100 = Few (F), 101-200 = Common (C), 201-400 = Abundant (A), and >400 = Dominant (D).

IV. RESULTS

4.1 Physico-Chemical Parameters

The temperature recorded during the period of the study ranged between 27°C and 29.5°C with a mean of 28°C. The highest temperature was recorded between weeks 1-6 (29.2°C ± 1.0) in the month of February and March. The dissolved oxygen value recorded during the period of this study ranged between 6.5-7.2mg/L with slight fluctuation throughout the duration of the study. The highest DO value of 7.3mg/L was recorded in week 21 in the month of July and the lowest value of 6.5mg/l was recorded in week 5, 6 (March) and week 13 (May).

The pH recorded during the period of the study ranged between 6.1 and 6.5. The highest pH, 6.54 was seen in week 23 (August) and lowest 6.1 in week 3 (February). The salinity recorded ranged between 0.2ppt and 11ppt with the highest (11ppt) occurring in week 3 (February) of the study and lowest (0.21ppt) occurring in week 22 (July) of the study.

Table 1: Physico-chemical Parameters of the Middle Reach of the Sombreiro River

Parameters	Range	Mean	Standard Error (±)
Temperature °C	27-29.5	28.25	0.05
Ph	6.1-6.5	6.38	0.05
Dissolved Oxygen (mg/L)	6.5-7.2	6.96	0.05
Salinity	0.2-11	3.45	0.05

4.2 Fish Species Composition

Table 2: Checklist of Total Fish Caught in the Middle Reach of the Sombriero River

S/N	Species	Genus	Family	Order
1	*Arius gigas*	*Arius*	Ariidae	Siluriformes
2	*Arius latiscutatus*	*Arius*	Ariidae	Siluriformes
3	*Tylosurus acus acus*	*Tylosurus*	Belonidae	Beloniformes
4	*Cynoglosus senegalensis*	*Cynoglosus*	Cynoglossiidae	Plueronectiformes
5	*Syacium guineensis*	*Syahcium*	Paralichthyidae	Plueronectiformes
6	*Dasyatis margarita*	*Dasyatis*	Dasyatidae	Myliobatiformes
7	*Elops lacerta*	*Elops*	Elopidae	Elopiformes
8	*Saurida caribbaea*	*Saurida*	Synodontidae	Aulopiformes
9	*Sardinella madenensis*	*Sardinella*	Clupeidae	Clupeiformes
10	*Ilisha africana*	*Ilisha*	Pristigasteridae	Clupeiformes
11	*Lophius vaitlanti*	*Lophius*	lophidae	Lophiformes
12	*Liza falcipinnis*	*Liza*	Mugilidae	Mugiliformes
13	*Mugil cephalus*	*Mugil*	Mugilidae	Mugiliformes
14	*Trachinotus teraia*	*Trachinotus*	Carangidae	Perciformes
15	*Carangoides malabaricus*	*Carangoides*	Carangidae	Perciformes
16	*Alectis indica*	*Alectis*	Carangidae	Perciformes

17	*Caranx hippos*	*Caranx*	Carangidae	Perciformes
18	*Sarotherodon melanotheron*	*Sarotherodon*	Cichlidae	Perciformes
19	*Coptodon zillii*	*Tilapia*	Cichlidae	Perciformes
20	*Oreochromis mossambicus*	*Oreochromis*	Cichlidae	Perciformes
21	*Pomadasys jubelini*	*Pomadasys*	Haemulidae	Perciformes
22	*Pomadasys argenteus*	*Pomadasys*	Haemulidae	Perciformes
23	*Pomadasys perotaei*	*Pomadasys*	Haemulidae	Perciformes
24	*Psuedotolithus elongatus*	*Psuedotolithus*	Scaiaenidae	Perciformes
25	*Psuedotolithus senegalensis*	*Psuedotolithus*	Scaiaenidae	Perciformes
26	*Lutjanus goreensis*	*Lutjanus*	Lutjanidae	Perciformes
27	*Lutjanus dentatus*	*Lutjanus*	Lutjanidae	Perciformes
28	*Drepane longimana*	*Drepane*	Drepaneidae	Perciformes
29	*Monodactylus sebae*	*Monodactylus*	Monodactylidae	Perciformes
30	*Sphyraena guachancho*	*Sphyraena*	Sphyraenidae	Perciformes
31	*Scomberomorous tritor*	*Scomberomorous*	Scombridae	Perciformes

Of the 40,509 fish specimens sampled during the study period (24 weeks) there was a total 31 species belonging to 26 genera, from 20 families and 10 orders, (Table 2- Checklist of Fish Species) recorded from the total catch. The overall composition of families and species were; the Carangidae with four species (*Trachinotus teraia*, *Carangoides malabaricus*, *Alectis indica*, *Caranx hippos*) in four (4) genera; the Cichlidae with three species (*Coptodon zillii, Sarotherodon melanotheron, Oreochromis mossambicus*) in three (3) genera, Haemulidae with 3 species (*Pomadasys jubelini*, *Pomadasys argenteus, Pomadasys perotaei*) in one genera; Lutjanidae, Sciaenidae and Ariidae, with two species each (*Lutjanus goreensis*, *Lutjanus dentatus*; *Psuedolithus elongatus*, *Psuedolithus senegalensis* and *Arius gigas, Arius latiscutatus* respectively) belonging to one genera each. Mugilidae had two species (*Liza falcipinnis, Mugil cephalus*) belonging to two genera. Interestingly 13 out of the 31 species, the Scombridae (*Scomberomorous tritor*), Belonidae (*Tylosurus acus acus*), Cynoglossiidae (*Cynoglosus senegalensis*), Paralichthyidae (*Syacium guineensis*), Dasyatidae (*Dasyatis margarita*), Elopidae (*Elops lacerta*), Synodontidae (*Saurida caribbaea*), Clupeidae (*Sardinella maderensis*), Pristigasteridae (*Ilisha africana*), lophidae (*Lophius vaitlanti*), Drepaneidae (*Drepane longimana*), Monodactylidae (*Monodactylus sebae*), Sphyraenidae (*Sphyraena guachandro*), all had a single species from one genera.

Table 3: Fish Species Composition Over Weeks

Week	Fish Species composition	Species Genera	Family	Orders
1	31	26	20	10
2	30	25	19	9
3	30	25	19	10
4	30	25	19	9
5	31	26	20	10
6	31	26	20	10
7	21	18	13	5
8	20	16	13	6

9	23	19	16	7
10	21	17	13	6
11	22	18	14	7
12	22	18	16	7
13	20	17	13	5
14	19	16	12	4
15	20	17	13	5
16	20	17	11	6
17	22	18	15	8
18	20	16	13	5
19	19	15	12	5
20	21	18	15	7
21	20	16	14	7
22	20	16	13	5
23	20	16	13	6
24	18	17	13	5

Secondly, results of the weekly Fish Species Composition (Table 3) showed a weekly variation in species composition, with weeks 1 to 6 having the highest species composition with a maximum of 31 species in 26 genera, in 20 families. After that was a drop in species composition from the weeks 7 to 24 with a range of 19 to 23 species from 15 to 19 genera. Week 1 had the highest species with 31 species from 26 genera. Finally, the least composition was known to occur in week 24, with 18 species in 17 genera, in 13 families.

Table 4a: Composition of Fishes in the Middle Reach of the Sombriero River, Rivers State

		WEEKS 1 to 12												
S/N	SCIENTIFIC NAME	1	2	3	4	5	6	7	8	9	10	11	12	Total
1	*Monodactylus sebae*	48	84	97	86	69	93	37	54	68	35	40	76	787
2	*Drepane longimana*	64	54	40	79	43	47	38	78	47	64	60	41	655
3	*Sarotherodon melanotheron*	151	133	99	76	75	78	55	56	69	73	64	62	991
4	*Sphyraena guachancho*	58	70	52	42	52	44	78	61	32	48	61	48	646
5	*Psuedotolithus elongatus*	66	86	39	96	40	51	86	64	99	87	70	85	869
6	*Psuedotolithus senegalensis*	182	136	115	133	92	95	15	21	27	26	23	5	870
7	*Arius gigas*	495	316	301	228	569	218	82	69	61	61	68	69	2537
8	*Tylosurus acus acus*	10	10	10	4	4	4	0	2	3	1	4	0	52
9	*Lutjanus goreensis*	66	56	82	57	78	72	13	63	36	37	27	45	632
10	*Ilisha africana*	1	1	0	2	1	1	0	0	2	0	0	4	12
11	*Trachinotus teraia*	16	25	12	27	15	25	0	0	0	0	0	0	120
12	*Pomadasys jubelini*	22	18	44	16	56	54	78	100	104	62	107	85	746
13	*Elops lacerta*	82	84	70	56	64	64	0	0	0	0	0	0	420
14	*Syacium guineensis*	14	16	10	4	12	7	1	0	1	0	0	1	66
15	*Carangoides malabaricus*	63	76	78	50	42	57	53	62	50	51	39	46	667
16	*Liza falcipinnis*	797	511	394	141	281	144	114	88	54	65	72	79	2740
17	*Mugil cephalus*	766	686	553	260	448	209	66	42	23	50	38	36	3177

18	*Pomadasys perotaei*	75	76	91	52	79	65	53	46	39	42	49	37	704
19	*Coptodon zillii*	64	69	105	50	55	47	63	64	77	79	56	62	791
20	*Lutjanus dentatus*	77	70	53	48	67	48	57	48	14	26	55	10	573
21	*Arius latiscutatus*	18	27	34	52	38	53	47	40	94	65	100	58	626
22	*Sardinella madenensis*	2569	2115	1912	1499	1773	1709	256	70	45	157	44	62	12211
23	*Lophius vaitlanti*	2	0	3	0	3	1	0	0	1	0	0	0	10
24	*Pomadasys argenteus*	11	11	6	21	6	8	0	0	0	0	0	0	63
25	*Saurida caribbaea*	1	2	3	2	2	2	0	0	0	0	1	1	14
26	*Alectis indica*	41	45	35	48	41	45	12	0	0	4	2	0	273
27	*Oreochromis mossambicus*	42	48	50	50	14	30	36	43	23	23	30	30	419
28	*Cynoglosus senegalensis*	10	5	11	23	19	19	3	6	2	2	3	6	109
29	*Caranx hippos*	4	6	5	12	3	6	0	0	0	0	0	0	36
30	*Scomberomorous tritor*	53	47	64	55	50	58	0	0	0	0	0	0	327
31	*Dasyatis margarita*	4	3	3	4	3	4	0	0	0	0	0	0	21
	Total	5872	4886	4371	3273	4094	3358	1243	1077	971	1058	1013	948	32164

Details of the weekly Fish Species Composition (Tables 4a and 4b) revealed a variation in the composition of various fish species in the catch from the study area over the weeks of the study. Although the identified 31 fish species were present at the onset (week 1) of the study, the 2nd week was slightly different, with only one (1) species absent (*Lophius vaitlanti*).

Almost all the fish species were present in the catches from weeks two (2) to six (6), with the exception of *Lophius vaitlanti* and *Illisha africana,* which were either absent or presence in very low numbers (one to three species). Also in this period, there was a gradual drop in the availability of most fish species even though they were still in the catch; for instance, *Sardinella marderensis*, *Tylosorus acus acus*.

Subsequently, from the 7th week to the 24th week, the composition of the catch varied greatly with some species completely unavailable (*Caranx hippos*, *Scomberomorous tritor*, *Pomadasys argenteus, Trachinotus teraia* and *Dasyatis margarita*). The number of some species like *Alectis indica* and *Clynoglosus senegalensis* dropped drastically from the 7th week and became unavailable from the 13th week till the end of the sampling period. Other species like the *Illisha africana*, *Elops lacerta*, *Tylosorus acus acus*, *Saurida carribea*, *Lophius vaitlanti*, *Syacium guineensis* were not consistently available, being available at some time and absent at other times, all the time in extremely low numbers. Species like the *O. mossambicus* were regular in the catch, though varying in number, all through. Most interestingly, *Tylosorus acus acus*, *Illisha africana* and *Lophius vaitlanti* were either consistently absent/presence, and in extremely low numbers, from the onset to the end of the study.

4.4 Fish Species Abundance

4.4.1 The Relative Abundance of Fish species

The total relative abundance of the individual fish species (Table 5), showed *Sardinella maderensis* as the most abundant (30.58%) in the total catch followed in descending order by *Mugil cephalus* (8.53%), *Arius gigas* (7.60 %), *Liza falcipinnis* (7.49%), *Sarotherodon melanotheron* (4.11%), *Psuedotolithus elongatus* (4.06%), *Coptodon zillii* (3.76%), *Pomadasys jubelini* (3.59%), *Arius lasticutatus* (3.43%), *Monodactylidae sebae* (3.34%), *Pomadasys perotaei* (3.12%), *Psuedotolithus senegalensis* (2.90%), *Carangoides malabaricus* (2.79%), *Drepane longimana* (2.71%), *Sphyraena guachandro* (2.47%), *Oreochromis mossambicus* (2.09%), *Lutjanus goreensis* (1.83%), *Lutjanus dentatus* (1.74%), *Elops lacerta* (1.08%), *Scomberomorous*

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tritor (0.81%), *Alectis indica* (0.67%), *Trachinotus teraia* (0.30%), *Cynoglosus senegalensis* (0.27%), *Sycium guineensis* (0.17%), *Pomadasys argentus* (0.16%), *Tylosurus acus acus* (0.15%), *Caranx hippos* 0.09%, *Dasyatis margarita* and *Ilisha africana* both having (0.05%) each, *Saurida caribbaea* (0.04%) and the least contributing species- *Lophius vaitlanti* (0.03%).

Table 5: The Relative Abundance of the Fish Species in the Middle Reach of the Sombreiro River, Rivers State

S/N	SCIENTIFIC NAME	FAMILY	Total Number of Fish Caught	Relative Abundance %	Legend of Rarity
1	*Arius gigas*	Ariidae	3080	7.60	D
2	*Arius latiscutatus*	Ariidae	1389	3.43	D
3	*Tylosurus acus acus*	Belonidae	61	0.15	F
4	*Cynoglosus senegalensis*	Cynoglossiidae	111	0.27	C
5	*Syacium guineensis*	Paralichthyidae	68	0.17	F
6	*Dasyatis margarita*	Dasyatidae	21	0.05	R
7	*Elops lacerta*	Elopidae	439	1.08	D
8	*Saurida caribbaea*	Synodontidae	18	0.04	R
9	*Sardinella madenensis*	Clupeidae	12386	30.58	D
10	*Ilisha africana*	Pristigasteridae	19	0.05	R
11	*Lophius vaitlanti*	Lophidae	12	0.03	R
12	*Liza falcipinnis*	Mugilidae	3034	7.49	D
13	*Mugil cephalus*	Mugilidae	3457	8.53	D
14	*Trachinotus teraia*	Carangidae	120	0.30	C
15	*Carangoides malabaricus*	Carangidae	1129	2.79	D
16	*Alectis indica*	Carangidae	273	0.67	A
17	*Caranx hippos*	Carangidae	36	0.09	R
18	*Sarotherodon melanotheron*	Cichlidae	1665	4.11	D
19	*Coptodon zillii*	Cichlidae	1523	3.76	D
20	*Oreochromis mossambicus*	Cichlidae	846	2.09	D
21	*Pomadasys jubelini*	Haemulidae	1453	3.59	D
22	*Pomadasys argenteus*	Haemulidae	63	0.16	F
23	*Pomadasys perotaei*	Haemulidae	1265	3.12	D
24	*Psuedotolithus elongatus*	Scaiaenidae	1644	4.06	D
25	*Psuedotolithus senegalensis*	Scaiaenidae	1175	2.90	D
26	*Lutjanus goreensis*	Lutjanidae	741	1.83	D
27	*Lutjanus dentatus*	Lutjanidae	703	1.74	D
28	*Drepane longimana*	Drepaneidae	1096	2.71	D
29	*Monodactylus sebae*	Monodactylidae	1354	3.34	D
30	*Sphyraena guachancho*	Sphyraenidae	1001	2.47	D
31	*Scomberomorous tritor*	Scombridae	327	0.81	A

1-50=Rare(R), 51-100=Few (F), 101-200=Common(C), 201-400=Abundance(A) and > 400 Dominant(D)

A general assessment of the Weekly Numerical Abundance (Figure 2) and Weekly Relative Abundance (%) of the fish species revealed that, the fish species exhibited varying levels of abundance (in number), per species, per week, throughout the twenty four weeks (24) of the study.

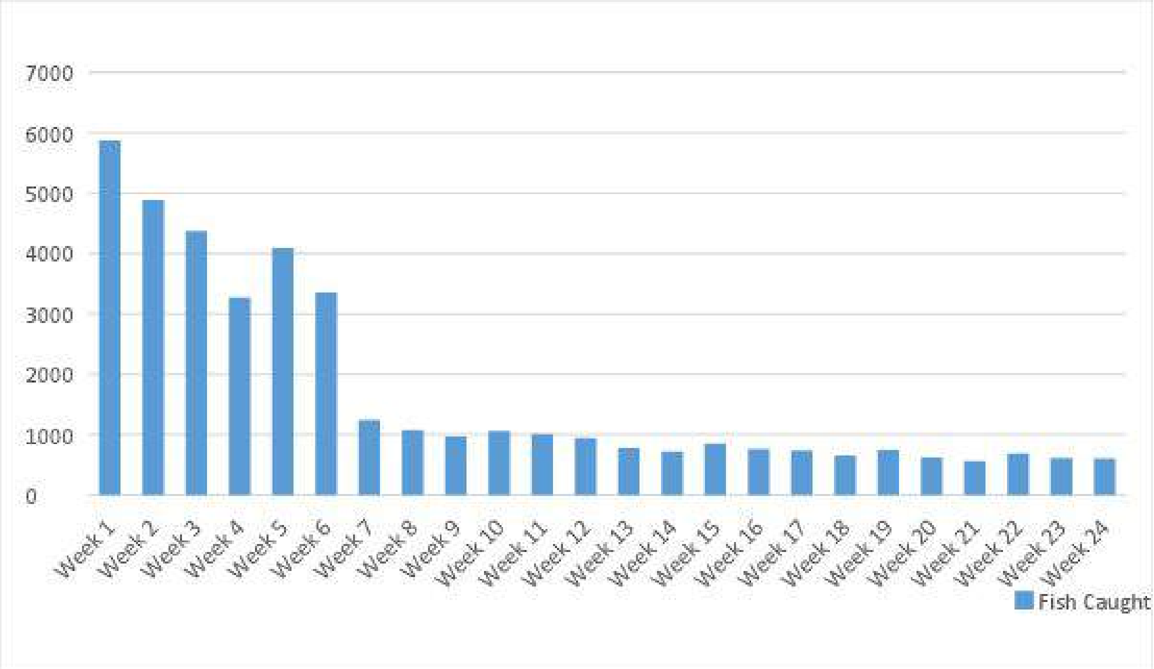

Figure 2: Weekly Numerical Species Abundance

As seen in Fig. 2, the fish species abundance from the first (1^{st}) week to the sixth (6^{th}) week of the study portrayed that, a majority of the species were highly abundant. This was followed by a sharp drop from the seventh (7^{th}) week towards the end (24^{th} week).

Weekly assessment of the Relative Abundance (%) in the first (1^{st}) week to the sixth (6^{th}) week of the study (table 6), showed that three of the species, *Sardinella maderensis* (43.24%-50.89%), *Mugil cephalus* (6.23% – 13.57%) and *Liza falcipinus* (4.29% – 14.04%) were the most abundant. Within this period also, some other species were moderately abundant (*Pseudotolithus senegalensis; 2.25% – 4.06%*). Some others exhibited very low species abundance (the *Illisha africana (0.0 – 0.06%)*, *Saurida carribea* (0.0% - 0.07%), and *Lophius vaitlanti(0.0% - 0.07%).* Infact, these three (3) were present at very low abundance and sometimes even absent.

Subsequently, from the 7^{th} week, there was a general sharp drop of the total abundance (fig. 2). There was also a noticeable sharp drop in some species abundance (table 5), as fish species exhibited varying levels of abundance towards the 24^{th} week.

Most species especially the highly abundant species (*S. mardarensis, M. cephalus* and *L. falcipinus)* dropped sharply towards week 24. The *Sardinella marderensis* for instance from an abundance of 43.75% species in week 1, dropped to 20.60% species in week 7, 3.6% species in week 13 and finally 1.0% in week 24.

Some species with a moderate abundance for instance, *A. gigas* dropped gradually from the 1^{st} week (8.43%), to the 7^{th} (6.6%), and then to the 22^{nd} week (5.25%).

Some other species with low abundance from weeks 1 to 6, for instance *Dasyatis margarita (0.06% – 0.12%), Caranx hippos (0.07%-0.37%), Pomadasys argenteus (0.14% – 0.64%) and Trachinotus teraia (0.27% – 0.82%)* became absent from the 7^{th} to the 24^{th} weeks. *Trachinotus* *teraia* with an abundance of 12 to 25 species in weeks 1 to 6, were absent from the 7^{th} – 24^{th} (0%, species)weeks. *Dasyatis margarita* with a maximum abundance of 4 species from weeks 1 to 6, were absent from the catch from the 7^{th} – 24^{th} weeks (0%, species).

Interestingly, some other species did not exhibit the downward drop (*Monodactylus sebae, Arius latiscutatus*, *Pomadasys jubelini*. *Illisha africana*, *Saurida carribea* and *Lophius vaitlanti),* though they were irregular in numbers through the study period. Rather, some of them seen to be moderately low in abundance at the early part of the study, later increased in abundance towards the 24^{th} week, such as *Arius latiscutatus* and *Pomadasys jubelini,* with 18(0,31%) and 22 (0.37%) species respectively in week 1, then to 100(11.75%) and 114(13.4%) respectively in week 15. But by the 24^{th} month, all fishes available were very low in number/abundance.

Secondly, though several species became absent from the catch at some point, several other species *Drepane longimania*, *Monodactylus sebae, Arius latiscutatus*, *Pomadasys jubelini* and *Coptdon zilli*, among others, were observed to be available all through the study period. Among these, the *Illisha africana*, *Saurida carribea* and *Lophius vaitlanti,* exhibited very low and irregular abundances(between 0 and 3 species). These species (*Illisha africana*, *Saurida carribea* and *Lophius vaitlanti),* exhibited the lowest abundance all through the study period 0.02% – 0.42%, 0.02% - 0.16% and 0.03% – 0.26% respectively.

The *Coptdon zilli* was noted to be the most stable but low in abundance all through the study period.

Table 6: Weekly Relative Species Abundance (%)

		Weekly Relative Abundance %																								
	Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	Total
1	*Monodactylus sebae*	0.82	1.72	2.22	2.63	1.69	2.77	2.98	5.01	7	3.31	3.95	8.02	4.11	6.49	8.34	7.17	5.29	5.06	7.88	7.42	4.44	8.67	8.36	8.14	5.15
2	*Drepane longimana*	1.09	1.11	0.92	2.41	1.05	1.4	3.06	7.24	4.84	6.05	5.92	4.32	5.14	4.7	6.93	3.91	4.88	5.37	6.14	4.03	4.62	6.07	4.26	6.98	4.27
3	*Serotherodon melanotheron*	2.57	2.72	2.26	2.32	1.83	2.32	4.42	5.2	7.11	6.9	6.32	6.34	7.46	3.87	7.52	7.56	6.65	8.74	12.82	8.71	6.75	14.16	6.07	6.15	6.12
4	*Sphyraena guachancho*	0.99	1.43	1.19	1.28	1.27	1.31	6.28	5.66	3.3	4.54	6.02	5.06	5.01	2.35	4.11	4.69	5.7	4.91	2.54	5	6.57	3.18	4.1	3.32	3.74
5	*Psuedotolithus elongates*	1.12	1.76	0.89	2.93	0.98	1.52	6.92	5.94	10.2	8.22	6.91	8.97	4.76	10.08	6.11	10.43	12.21	9.66	8.28	10.48	10.3	8.38	11.8	10.8	7.07
6	*Psuedotolithus senegalensis*	3.1	2.78	2.63	4.06	2.25	2.83	1.21	1.95	2.78	2.46	2.27	0.53	0.9	4.01	3.88	2.09	3.39	5.37	3.87	4.03	3.91	4.77	3.93	4.49	3.06
7	*Arius gigas*	8.43	6.47	6.89	6.97	13.9	6.49	6.6	6.41	6.28	5.77	6.71	7.28	6.3	5.39	2.94	9.91	8.41	8.13	6.94	6.29	5.32	5.35	6.23	7.14	6.94
8	*Tylosurus acus rafella*	0.17	0.2	0.23	0.12	0.1	0.12	0	0.19	0.31	0.09	0.39	0	0	0	0.35	0	0.27	0	0.13	0.32	0	0.14	0	0	0.13
9	*Lutjanus goreansis*	1.12	1.15	1.88	1.74	1.9	2.14	1.05	5.85	3.71	3.5	2.67	4.75	3.47	1.8	0.71	1.43	0.95	1.53	0.4	0.97	2.31	0.43	0.98	0.66	1.96
10	*Ilisha Africana*	0.02	0.02	0	0.06	0.2	0.03	0	0	0.21	0	0	0.42	0	0.14	0.24	0	0	0.15	0	0.16	0.18	0.14	0	0	0.08
11	*Trachinotus teraia*	0.27	0.51	0.27	0.82	0.37	0.74	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.12
12	*Pomadasys jubelini*	0.37	0.37	1.01	0.49	1.37	1.61	6.28	9.29	10.71	5.86	10.56	8.97	7.07	11.05	13.4	12.91	5.7	7.67	6.41	8.87	7.99	5.49	7.05	6.31	6.53
13	*Elops lacerta*	1.4	1.72	1.6	1.71	1.56	1.91	0	0	0	0	0	0	1.54	0	0	0	0.27	0.15	0	0	0.36	0	0.33	0	0.52
14	*Syacium guineensis*	0.24	0.33	0.23	0.12	0.29	0.21	0.08	0	0.1	0	0	0.11	0	0	0	0	0.14	0	0	0.16	0	0	0	0	0.08
15	*Carangoides malabaricus*	1.07	1.56	1.78	1.53	1.03	1.7	4.26	5.76	5.15	4.82	3.85	4.85	6.3	3.18	4.23	3.26	5.29	6.44	6.14	6.61	7.1	6.07	6.39	6.64	4.38
16	*Liza falcipinnis*	13.57	10.46	9.01	4.31	6.86	4.29	9.17	8.17	5.56	6.14	7.11	8.33	7.2	4.42	2.59	2.35	2.58	4.91	3.6	2.74	3.2	3.61	1.48	3.17	5.62
17	*Mugil cephalus*	13.05	14.04	12.65	7.94	10.94	6.22	5.31	3.9	2.37	4.73	3.75	3.8	2.44	5.25	2.12	4.17	1.76	1.53	2.94	5	2.13	3.47	5.57	4.49	5.4
18	*Pomadasys perotaei*	1.28	1.56	2.08	1.59	1.93	1.94	4.26	4.27	4.01	3.97	4.84	3.9	9.77	7.32	4.23	6.39	7.06	5.21	5.21	6.29	7.99	5.78	8.03	8.14	4.88
19	*Coptodon zilli*	1.09	1.41	2.4	1.53	1.34	1.4	5.07	5.94	7.93	7.47	5.53	6.54	10.93	8.01	9.87	8.47	10.04	9.51	9.35	9.52	8.17	8.09	6.56	5.48	6.32
20	*Lutjanus dentatus*	1.31	1.43	1.21	1.47	1.64	1.43	4.59	4.46	1.44	2.46	5.43	1.05	2.19	1.66	3.41	1.3	1.22	1.38	1.87	0.97	0.89	1.3	1.15	0.5	1.91
21	*Arius latiscutatus*	0.31	0.55	0.78	1.59	0.93	1.58	3.78	3.71	9.68	6.14	9.87	6.12	7.1	12.15	11.75	8.6	9.77	7.36	6.94	7.26	11.01	7.95	9.34	10.47	6.45
22	*Sardinella madenensis*	43.75	43.29	43.74	45.8	43.31	50.89	20.6	6.5	4.63	14.84	4.34	6.54	3.6	1.1	1.88	2.61	3.26	2.91	3.47	0.81	1.6	1.16	0.98	1	14.69
23	*Lophius vaitlanti*	0.03	0	0.07	0	0.07	0.03	0	0	0.1	0	0	0	0	0	0	0.26	0	0	0	0	0	0	0	0	0.02
24	*Pomadasys argenteus*	0.19	0.23	0.14	0.64	0.15	0.24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.06
25	*Saurida caribbaea*	0.02	0.04	0.07	0.06	0.05	0.06	0	0	0	0	0.1	0.11	0	0	0	0.13	0.14	0	0	0.16	0	0	0.16	0	0.05
26	*Alectis indica*	0.7	0.92	0.8	1.47	1	1.34	0.97	0	0	0.38	0.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0.32
27	*Oreochromis mossambicus*	0.72	0.98	1.14	1.53	0.34	0.89	2.9	3.99	2.37	2.17	2.96	3.16	4.5	7.04	5.41	2.35	5.02	3.99	5.07	4.19	5.15	5.78	7.21	6.15	3.54
28	*Cynoglosus senegalensis*	0.17	0.1	0.25	0.7	0.46	0.57	0.24	0.56	0.21	0.19	0.3	0.63	0.26	0	0	0	0	0	0	0	0	0	0	0	0.19
29	*Caranx hippos*	0.07	0.12	0.11	0.37	0.07	0.18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.04
30	*Scomberomorous tritor*	0.9	0.96	1.46	1.68	1.22	1.73	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.33
31	*Dasyatis margarita*	0.07	0.06	0.07	0.12	0.07	0.12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.02

4.5 Species Abundance Score Over the Weeks

Based on the Relative abundance of the total number of species recorded in the study area over the study period(Table 5), the dominant species with the highest numbers recorded were the *Sardinella maderensis* , *Mugil cephalus* and *Liza falcipinus*. The *Arius gigas and Pseudotolithus senegalensis* were abundant; *Coptdon zilli* was observed to be few, and the *Illisha africana*, *Saurida carribea* and *Lophius vaitlanti* were rare. However an assessment of the Weekly Abundance score of fish species as seen in Table 7 revealed that, each fish species exhibited varying levels of availability in the study area over time, from Dominant(D) to rare (R). The result of the weekly abundance score revealed a descending trend from the 1st week towards the 24th week for most of the fish species. In the 1st to the 6th weeks, out of the thirty one (31) fish species in the landed catch, thirteen (13) were rare, ten (10) rare to few, two (2) common to few, five (5) few, three (3) dominant to common and one (1) only dominant all through (S. *maderensis*) this period. The Weeks 1 – 6 was the period when dominance to abundance was exhibited by some species (*Sardinella maderensis(D)*, *Mugil cephalus(D-A)*, *Illisha africana* (R). In Fact, the *Sardinella maderensis* were fully dominant up to the 6th week and the only abundant(A) species in the 7th week. In this period generally, the weekly abundance score showed that out of the thirty one (31) species identified in the study area, thirteen (13) species were rare(R), ten (10) species were moderately rare(R) to few(F), two (2) species were common(C) to few(F), five (5) species were few(F), three (3) species were dominant(D) to common(C) and one (1) species fully dominant(D). However out of the rare species, three (3) – *L. vaitlanti*, *I. africana* and *S. carribea* were extremely rare having a catch of three (3) species to none per landing of catch.

Subsequently, there was a distinct drop in the fish population. Weeks seven (7) to fourteen (14) showed, was a period that recorded low abundance, where out of the thirty one (31) species, two (2) were common to few (*P. jubelini* and *L. falcipinnis*), ten (10) were few to rare (*M. sebae*, *D. longimania,* etc), three (3) were few, three (3) were rare, eight (8) were between rare and absent and five (5) were completely absent.

Towards the end of the study (weeks 15 – 24), most of the species were either rare or completely unavailable with the exception of a few. Out of the thirty one (31) species, eight (8) were unavailable (S. *maderensis*, *C. senegalensis*, etc), five (5) were irregularly available (*I. africana*, *L. vaitlanti*, etc), eleven (11) were rare, five (5) were few to rare and only one (*P. jubelini*) was common to few.

Table 7: Abundance Score of Fish Species in the Middle Reach of the Sombreiro River

		WEEKS																							
S/N	**SPECIES**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
1	*M. sebae*	R	F	F	F	F	F	R	F	F	R	R	F	R	R	F	F	R	R	F	R	R	F	F	R
2	*D. lonimania*	F	F	R	F	R	R	R	F	R	F	F	R	R	R	F	R	R	R	R	R	R	R	R	R
3	*S. melanotheron*	C	C	F	F	F	F	F	F	F	F	F	F	F	R	R	F	R	R	R	R	R	R	R	R
4	*S. guachandro*	F	F	F	R	F	R	F	F	R	R	F	R	R	R	R	R	R	R	R	R	R	R	R	R
5	*P. elongates*	F	F	R	F	R	F	F	F	F	F	F	F	R	R	R	R	R	R	R	R	R	R	R	R
6	*P. senegaleensis*	C	C	C	C	F	F	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
7	*A.gigas*	D	C	C	C	D	C	C	F	F	F	F	F	R	R	R	F	F	F	F	R	R	R	R	R
8	*A.lastiscutatus*	R	R	R	F	R	F	R	R	F	F	F	F	F	F	F	F	F	F	R	F	R	F	R	R
9	*T. acus acus*	R	R	R	R	R	R	O	R	R	R	R	O	O	O	R	O	R	O	R	R	O	R	O	O
10	*Lutjanus goreensis*	F	F	F	F	F	F	R	F	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
11	*L. dentatus*	F	F	F	R	F	R	F	R	R	R	F	R	R	R	R	R	R	R	R	R	R	R	R	R
12	*L. africana*	R	R	O	R	R	R	O	O	O	O	O	R	O	R	R	O	O	R	O	R	R	R	O	O
13	*T. teraia*	R	R	R	R	R	R	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
14	*Pomadasys jubelini*	R	R	R	R	F	F	F	F	C	F	C	F	F	F	C	F	R	R	R	F	R	R	R	R
15	*P. perotatei*	F	F	F	F	F	F	F	R	R	R	R	R	F	F	R	F	R	R	R	R	R	R	R	R
16	*P. argenteus*	R	R	R	R	R	R	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
17	*Elops lacerta*	F	F	F	F	F	F	O	O	O	O	O	O	R	O	O	O	R	R	O	O	R	O	R	O
18	*Syacium guineensis*	R	R	R	R	R	R	R	O	R	O	O	R	O	O	O	O	R	O	O	R	O	O	O	O
19	*C. malabrius*	F	F	F	R	R	F	F	F	R	F	R	R	R	R	R	R	R	R	R	R	R	R	R	R
20	*Caranx hippos*	R	R	R	R	R	R	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
21	*S. tritor*	F	R	F	F	R	F	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O
22	*Liza falcipinus*	D	D	A	C	A	C	C	C	F	F	F	F	F	R	R	R	R	R	R	R	R	R	R	R
23	*Mugil cephalus*	D	D	D	A	D	A	F	R	R	F	R	R	R	R	R	R	R	R	R	R	R	R	R	R
24	*Coptodion zilli*	F	F	C	F	F	R	F	F	F	F	F	F	F	F	F	F	F	F	F	F	R	F	R	R
25	*S. maderensis*	D	D	D	D	D	D	A	F	R	C	R	R	R	R	R	R	R	R	R	R	R	R	R	R
26	*Lophius vaitlanti*	R	O	R	O	R	R	O	O	R	O	O	O	O	O	O	R	O	O	O	O	O	O	O	O
27	*Sauridea carribea*	R	R	R	R	R	R	O	O	O	O	R	R	O	O	O	R	R	O	O	R	O	O	R	O
28	*Alectia indica*	R	R	R	R	R	R	R	O	O	R	R	O	O	O	O	O	O	O	O	O	O	O	O	O
29	*O. mossambicus*	R	R	R	R	R	R	R	R	R	R	R	R	O	O	O	O	O	O	O	O	O	O	O	O
30	*C. senegaleensis*	R	R	R	R	R	R	R	R	R	R	R	R	R	O	O	O	O	O	O	O	O	O	O	O
31	*D. margarita*	R	R	R	R	R	R	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O	O

Key: D-DOMINANT, A-ABUNDANT, C-COMMON, F-FEW, R-RARE and O- NOT AVAILABLE

Finally, three (3) species (– *I. africana*, *L. vaitlanti and S. carribea*) were regularly observed to be extremely rare (R) all through the period of study. Seventeen (17) of the species were available all through, although in varying numbers. Eight (8) species were unavailable most of the period (D. *margarita*, *Caranx hippos*, S. *tritor*, P. *argenteus*, T. *teraia and others*), Six (6) fluctuated in abundance level. *Coptdon zilli* was the most stable being low in abundance/few all through the study period. But by the 24th month, all fishes available were very low in number/ abundance.

4.6 Statistical Analysis of Abundance Over Weeks

Statistical analysis of the species abundance (Table 8), showed that, fish species abundance was highest at the beginning (1st -2nd week) and then 3rd to the 6th week, with a drop towards the end (24th week). Secondly, the abundance through the weeks were significantly different with Week 1 and 2 significantly different from each other, and highly significantly different from the other weeks. Thirdly, weeks 3 to 6; 8 to 12 and 15; 13, 14, 16 to 24 were similar, but were significantly different from each other.

Table-8: Statistical Analysis of Fish Species Abundance Over Weeks

Weeks	Abundance
1	1.495 ± 0.1^{ab}
2	1.2062 ± 0.1^{b}
3	1.079 ± 0.1^{a}
4	0.808 ± 0.1^{a}
5	1.011 ± 0.1^{a}
6	0.829 ± 0.1^{a}
7	0.307 ± 0.1^{e}
8	0.265 ± 0.1^{c}
9	0.240 ± 0.1^{c}
10	0.261 ± 0.1^{c}
11	0.250 ± 0.1^{c}
12	0.234 ± 0.1^{c}
13	0.192 ± 0.1^{d}
14	0.117 ± 0.1^{d}
15	0.210 ± 0.1^{c}
16	0.189 ± 0.1^{d}
17	0.182 ± 0.1^{d}
18	0.161 ± 0.1^{d}
19	0.185 ± 0.1^{d}
20	0.153 ± 0.1^{d}
21	0.139 ± 0.1^{d}
22	0.171 ± 0.1^{d}
23	0.151 ± 0.1^{d}
24	0.149 ± 0.1^{d}

V. DISCUSSION

The total species composition of 31 fish species belonging to 20 families in 26 genera identified from a total of 40,509 fishes indicates the existence of a good composition of fish species/ families in this river section. There is paucity of information on the fin-fish species assemblage in the Middle Reach of the Sombriero River. However, the result of the only known work from the freshwater, upper section of the Sombriero River by Onwuteaka (2015) reported 79 fish species. Other works in the adjoining brackish New Calabar River (Nwadiaro and Ayodele (1992), (Olori (1995), Nwadukwe (2000), Ibim and Igbani (2014)), and Okpoka River, (Davis, 2009) in the Niger Delta, reported similar composition as the brackish Middle reach of the Sombreiro. Ibim and Igbani (2014), reported a fish composition of 36 species from 29 families in the lower New Calabar River, Chinda (1994) recorded fish composition of 57 species from 25 families from the Bonny River and Ezekiel *et al (2002)* in the Odhiokwu-Ekpeye local fish ponds and floods plains had 25 species of fishes from 16 families

Chinda and Osuamkpe (1997) and Davis (2009), reported that the high numbers of composite fauna recorded in their studies could be associated with the nutrient richness of the estuarine environment of the Niger Delta basin in which the Mid. Reach of the Sombreiro River is also located. The fish species and their levels of availability as reported in the middle reach of the Sombreiro were also reported in the adjoining rivers of the Niger delta. Similar high numbers/ dominance of clupeids, mugils and cichlids were reported by Davis (2009), and Ibim and Igbani

(2014) in the Okpoka River and New Calabar River respectively. According to Onwuteaka (2015), it has been hypothesized that fish species diversity is mainly influenced by fine-scale environmental factors such as interconnectivity of rivers and streams. They reported that this could be due to their prolific reproductive characteristics, hardiness and better adaptability to various environmental parameters as well as availability of high concentration of planktons.

The fish species composition within weeks/over the period of the study, similarly showed a high composition of Fish species in the Middle Reach of the Sombreiro river, however there were observed variations in the composition indicating a Seasonal variation of composition that was high in weeks 1 -6 being the dry season followed by a sharp drop in composition for most species in weeks 7 to 24, the period of early rains to full wet season. This is consistent with the findings of Fagade and Olaniyan (1974), Chindah and Osuamkpe (1994), Otobo (1995) Allison *et al* (1998), Sikoki *et al* (1999), Nweke (2000), Ebere (2002), Davies (2009) and Onwuteaka (2015). According to Fagade and Olaniyan (1974), the relative environmental stability, water-flow and improved light penetration resulting in increased photosynthetic activities and plankton production could be responsible for this seasonal variation. The trend of seasonal variation can also be attributed to migration for several reasons in response to biotic and abiotic situations. Onwuteaka (2015) reported that, in the Niger Delta a major challenge for river and stream fish ecologists is the identification of the mechanisms and processes responsible for fish composition in relation to biotic and abiotic factors.

In some cases migration could be in response to physico-chemical conditions of the water body. In this case, the salinity of the Sombreiro for weeks 1 to 6 were high (11 parts per thousand(ppt)). and stable, but later on when the early rains commenced (week 7) the salinity dropped, then to the full wet season,(weeks 8- 24) the salinity became very low (0.2ppt) due to the dilution effect of the rains and floods. Most of the species recorded here are purely brackish water to marine species for instance, *Sardinella marderensis, Dasytatis margarita and Cynoglosus senegalensis (*Fagade and Olaniyan (1974), Ibim and Igbani (2014) and Onwuteaka (2015)). Alteration in the physico-chemical parameters by rainfall dilution /flood inundation can result in migration of pure brackish water species away from the water body (Onwuteaka, 2015) He reported in his study that drastic physical and chemical changes as a result of the large contribution of the River Niger water was responsible for lower catches in the wet season in the Upper reach of the Sombreiro. Also Soyinka and Kassem (2008), attributed the observed slight seasonal variation in the catch composition of the Lagos lagoon fish fauna to seasonal fluctuation in salinity, marked with higher rainfall volumes in the rainy season than in the dry season. Thus, Salinity could be responsible for the unavailability of some species.

In the case of migration in response to reproduction, anadromous fish species migrate away to freshwater for reproductive purposes as the rainy season is known as a major reproductive season for fishes. Tuos *et al* (2015), reported that the *Sardinella maderensis* breeds once a year between July-September when juveniles and adults show clear north-south migrations in the Gabon-Congo-Angola sector of their range and also in the Sierra Leone-Mauritania sector, each area having nurseries. The movements are correlated with the seasonal upwelling.

Also the region of residency in a River can be of great importance in the variation in catch of fish species. Chindah (1994) on the fish assemblage in the Bonny Creek reported that variation in composition was as a result of some species being resident in the main river whilst others were creek residents. However, overfishing/high exploitation in the dry season is a major challenge. It was reported that (personal communication) fishing activities are higher in the dry season as the water levels were lower, the river was calmer. Also, larger fishes were much more easy to catch.

The abundance of fish species varied widely with some species highly dominant, others abundant, common and rare. The abundance pattern of fish species in the mid-Sombreiro is as obtained in most brackish water environments in the Niger Delta south and is consistent with the findings of Chindah and Osuamkpe (1997), in the lower Bonny River; Davis (2009) in the Okpoka Creek and Ibim and Igbani (2014), in the New Calabar River. The high abundance of the dominant species, the Mugilidae (*Mugil cephalus* and *Liza falcipinnis*) and the Clupidae (*Sardinella maderensis*) in the fish catch were consistent with the findings of Davis (2009) in Okpoka Creek, and Sikoki *et al*. (1999) in the Brackish parts of Brass river. This was also the similar to the findings in the lower New Calabar River by Ibim and Igbani (2014). It was reported that the dominance of the Clupidae and the Mugilidae are as a result of the high nutrient status of the Niger Delta Creeks, which have high algal population (phytoplankton and epiphyton) that serve as food organisms for these species (Allison *et al*. (1997); Ogamba (1998) and Davis (2009)). Also, the high catch of the *Sardinella maderensis* could be connected to the fact that they move in schools (Shaw and Drullinger, 1990).

However, a majority of the fish species were rare or low in abundance (R). For instance, the *Lophius vaitlanti, Dasyatis margarita, Ilisha africana and Suarida carribbaea* were rare(R) and thus endangered. The reason for this was not known, but it was reported (Pers. Comm.) that the coastal communities along the River are known to consume and trade on fish as a major source of protein and most fishes with low abundance/ score are either the large species, that are appreciated for food (*Ilisha africana*), and those that attract good income (*Cynoglossus senegalensis* and *Dasyatis margarita*). Also, Morgan (1997) reported that many fish species were declining in abundance as a result of human activities that leads to habitat degradation and destruction, such as the oil exploration activities around the river.

Result of the fish species Abundance (weekly) over the period of the study varied for different Fish species in the Middle Reach of the Sombreiro river, as observed with the weekly composition. This indicated a Seasonal variation in abundance with high species numbers in weeks 1 -6, the dry season, followed by a sharp drop in abundance for most species in weeks 7 to 24, the period of early rains to full wet season. This is consistent with the findings of Fagade and Olaniyan (1974), Otobo (1995), Chindah and Osuamkpe (1997), Allison *et al* (1998), Sikoki *et al* (1999), Nweke (2000), Ebere (2002), Soyinka and Kassem(2008), Davies (2009) and Onwuteaka (2015

The high abundance of the dominant(D) species the Mugilidae and the Clupidae, having higher numbers in the dry season (first six weeks) than the wet season were consistent with the findings of Fagade and Olaniyan (1974) and Osuamkpe (1994)Soyinka and Kassem (2008), and Davis (2009). This phenomenon may have been as a result of a more stable environmental condition at the dry season (Soyinka and Kassem, 2008). In cases where fishes migrate, they tend to migrate seasonally, possibly to take advantage of their prey. Fagade and Olaniyan (1974) and Soyinka and Kassem(2008) reported that seasonal variation in fishes is attributed to the occurrence of high plankton population density in rivers during the dry season than the rainy season. Chindah and Osuamkpe(1997) and Davis (2009) reported the abundance of the *Sardinella* species in the Niger Delta Area as a result of high abundance of planktonic organism for food. In the Sombreiro, Ezekiel *et al* (2011) reported significant seasonal variation between the mean values of macrobenthic fauna of wet season and the dry season. The dry season had higher values than the wet season. This will further sustain the fishes in the dry season.

The unavailable species during the rainy season can be associated with several reasons. Eight (8) species were unavailable at this period (*D.*

margarita, *Caranx hippos*, *S. tritor, P. argenteus, T. teraia* and others*)*. One of the reasons for the unavailability of these species could be the reduction in food organisms. It was reported that in the rainy season there was a reduction in plankton population (Chindah and Osuamkpe, (1997), Tackx *et al* (2004), Soyinka and Kassem (2008) and Davis, (2009)), resulting in migration of fish species that depend on them for food. Abowei *et al* (2008) reported similar reduction in zooplanktons population in the lower Sombreiro. They reported that even though the reduction was not significantly different between seasons, the abundance decreased with decreasing conductivity. Ezekiel *et al* (2011) reported a reduction in macro-benthic population in the rainy season in the lower Sombreiro. Hoff (1971) reported that in Nigeria, and presumably other parts of Africa, the *Caranx hippos* species appears to migrate seasonally, possibly to take advantage of prey. These species feed mainly on the clupeids, and at this period they were very low in abundance. Fishing methods, fishing season and industrial activities, causing biological overfishing of the stock in the area can also be responsible (Sikoki, 1998). Also, these species are true brackish water fishes (Ibim and Francis, 2012). The dilution in the salinity in the from 11 ppt in the dry season to a freshwater salinity of 0.2ppt is a major issue for their survival, thus it is possible that they migrated to more saline areas.

The twenty three(23) species that were available all through in varying numbers amongst which were the Cichlidae (*Coptodon zilli and S. melanotheron*) were the hardy and euryhaline species that also complete their life cycle in the river (Soyinka and Kassem, 2008). Schneider (1990) and Fagade and Olaniyan (1974), reported that *Elops lacerta* is another hardy species found all year-round in estuaries. With regards to the fish species which were noted to be fairly low in abundance at the early part of the study and increased in abundance later such as *Arius latiscutatus*, it could be inferred that this is as a result of intra /interspecific competition especially as it is more common when two species of a genera occur. Thus interspecific competition is likely between *Arius gigas* and *Arius latiscutatus* as one species dropped in abundance e.g. *Arius gigas*, while the other, *Arius latiscutatus* picked – up. This was also observed with both *Pomadasys jubelini and P. argenteus* species.

Thirteen species had very low abundance/rare and and it can be inferred that overfishing may be a major factor affecting their population. This could be attributed to the fact that most of them are large attractive fishes which are sold at good prices commercially. Example of such is the *Dasyatis margarita*, which currently is reported as endangered (EN) in Online Fishbase.

The least abundant three (3) species – *I. africana, L. vaitlanti and S. carribea*)) species were drastically low in numbers/rarity (R) all through the period of study. The very low occurrence of *Illisha africana* can be associated with the fact that it is a delicacy in the Niger Delta area as a result of their acceptability and palatability. Adults and juveniles are fished massively and sold for industrial and domestic purposes. They were also reported as bycatch in shrimp nets. They are killed in the estuaries as a result of crude oil and anthropogenic pollution as well as habitat loss. However they were reported not to be overfished but fully exploited. They were thus declared of least concern (LC) by the IUCN (Ambrose *et al.* 2005, Francis and Samuel, 2010, and Francis *et al.* 2007 in Munroe *et al.*, 2016). But, the extremely rare to non-available existence is an indication that they have now become threatened in the Sombreiro river. The *S. carribea* and *L.vaitlanti* also have not been reported vulnerable or threatened yet. However, it is possible that over fishing has occurred. Also predation could be responsible for their extremely rare to non-available existence as there are several large fish species for which they are food fish in this river. In the Okrika river, in the Niger Delta basin, the Lophidae are also known to occur in this very rare condition (Personal com.) it is thus possible that these species occur in low populations naturally.

VI. CONCLUSION AND RECOMMENDATIONS

Generally, the middle reach of the Sombreiro River consists of a good composite fauna of fish species similar to the fish species composition of other rivers in the Niger Delta Area. The status of the fish species generally, showed a variation in the abundance of fish species of the area, with the presence of dominant, abundant, few and rare species. This variation was more prominent through the study period, where the abundance varied significantly. It was observed that, thirteen (13) of the identified thirty one(31) species are rare, eight(8) are unavailable in the rainy season and three(3) are critically low. Although several reasons could be attributed to the seasonal variation, the most likely could be the high variation in salinity of the water body. Therefore it is recommended that appropriate, targeted research be carried out to identify the true reason for the seasonality and the threats affecting fish species status in this study environment, quick intervention in management strategies be developed, and protection/ conservation measures be carried out urgently to save these species from going extinct.

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