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Food and Feeding, Length-Weight and Condition Factor of the Catfish *Synodontis membranaceus* (EtieneGeoffroy Saint Hilaire, 1809) (Osteichthyes: Mochokidae) from Lower Benue River, Makurdi, Nigeria

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Abstract: Food and Feeding, length-weight and condition factor of the Catfish *Synodontis membranaceus* from the Lower Benue River at Makurdi, Nigeria, was studied for 12- month period from July, 2013 to June, 2014. A total number of 202 specimens, comprising of 101 males and 101 females at a ratio of 1:1 were studied. The Length-Weight Relationship (LWR), correlation coefficient (r) for all males and females were highly positive and significant at ($P<0.01$), with r values of 0.972 for males, 0.899 for females and 0.952 for combined sexes. The mean b values (regression coefficient) were 2.68 in all the males, 2.46 in all the females and 2.63 in combined sexes indicating that all the sexes had negative allometric growth pattern. The mean condition factor (K) for both sexes ranged from 2.21-3.35. The lowest K range (1.81) for males was observed in July, 2013 while the highest K range (3.05) was observed in April, 2014. Similarly, the lowest K range (1.83) for females was observed in August, 2013 with the highest K range of 3.14 in the same month. Out of the 202 stomachs examined, only 9 males (8.91%) and 5 females (4.95%) had empty stomachs, about 91.09% of males and 95.0% of females had varied quantities of food items in their stomachs. *Synodontis membranaceus* in the Lower Benue River was found to be omnivorous, feeding on food items, which included artificial meal, plant remains, variety of algae, insect parts and larvae, bivalves (*Molluscs*), crustaceans, protozoa, worms, detritus, sand particles and mud and many unidentified quantities of food items.

Keywords: *Synodontis membranaceus*, Food, Feeding, Lower Benue River

1. Introduction

Fish, as all animals, require adequate nutrition in order to grow and survive. Some fish feed on plant materials; others feed only on animals, whereas a third and larger group derive their proteins, carbohydrates and fats, as well as vitamins and minerals necessary for their growth and maintenance, from both plant and animal sources (Lagler, *et al.,* 1977). According to Akange (2011), no species of fish is associated with a particular kind of food item. Feeding of fish therefore, depends on the abundance and availability of potential food items (Lagler *et al.,* 1977). *S. membranaceus has* been found to be a typical example of fish without strict feeding habit and it is regarded as omnivore, because of its ability to use any food material available in its habitat (Owolabi, 2008). The feeding habits of fish as well as its feeding habits influence its growth, behaviour and other ecological characteristics (Ogbe *et al.,* 2008).

The study of food and feeding of fish based on stomach content analysis is widely used in fish biology and ecology to indicate the position of a species within a food web and to provide information on the contribution of different prey items to the diet (Bagenal, 1978). Food items consumed by fish are ascertained by carefully observing their stomach content especially after feeding. Data on stomach composition is vital in providing straight forward models of stomach content dynamics and formulating management strategy options in multi-species fishery (Adeyemi *et al.,* 2009).

The study of the food and feeding of freshwater fish species is a subject of continuous research because it constitutes the basis for the development of a successful fisheries management programme on fish culture (Oransaye and Nakpochia, 2005). Berg (1979) reported that the analysis of stomach content of fish could provide information about the niche of a particular fish in its ecosystem and this has become a standard practice in fish ecology works.

Extensive research has been carried out on the Lower Benue River which includes that of Ogbe and Fagade (2002), Ogbe *et al.,* (2008), Solomon *et al.,* (2009), Akombo *et al.,* (2011) on *Hydrocynus forskalii, Alestes nurse and Synodontis* respectively. However, So far, no extensive work has been done on the food and feeding habit of *S. membranaceus* from Lower Benue River, Nigeria. Hence there is a need to investigate food and feeding behavior of this fish in order to know more of its biological and physiological aspects to sustain fish farming of *Synodontis membranaceus*, through aquaculture industry which will provide biological and statistical information on the Lower Benue River Fisheries and as well as provide information on the formulation of fish diet relevant for aquaculture.

2. Materials and Methods

2.1. Description of the Study Area

The study was carried out in the Lower Benue River, Makurdi. The Lower Benue River as described by Reid and Sydenhan (1979) is the portion of the Benue River contained within the Benue State of Nigeria. River Benue originates mainly in the Adamawa Mountains of Cameroun, some 500 km beyond the Nigerian frontier, and flows west across East-Central

Nigeria (Nedeco, 1959). It is the largest tributary of the Niger which joins at Lokoja. The River has extensive alluvial plain (uncommon in African Rivers) stretching for many kilometers, covering a distance of approximately 187 km. This extensive flood plain forms breeding grounds for many fish species (Beadle, 1974). The highest water levels are in August to September and the lowest are in March to April (Akombo *et al.,* 2011). (Be brief and concisein describing the study area)

2.2. Sampling Method

The fresh specimens of *Synodontis membranaceus* were purchased from the fishermen at Wurukum and Wadata markets with which the biggest fish are located in Makurdi. Bi-monthly purchasing of the specimens from the landing sites was taken for twelve months-period from July, 2013 to June, 2014. The fish samples purchased were then transported to the laboratory in plastic containers containing ice blocks to keep the fish fresh.

2.3. Morphometric Measurements

The morphometric parameters measured were length (SL) and body weights (BW). SLs of the specimens were determined by using a measuring board as described according to Akombo *et al.,* (2011). The BW were monitored using a digital electronic weighing balance, (ADAM AFP 4100L). The specimens were weighed to the nearest 0.1 g.

2.4. Determination of Sex

The sex of *S. membranaceus* was determined after dissecting the fish. Mid-ventral incision on the abdomen of the fish was performed from the anal opening to the end of opercula region to expose the internal organs. In the young males, testes are described as thin, thread –like with very small projections, whitish in colour and extend to about one-third of the abdominal cavity. In adult males, they are creamy in colour with very conspicuous granules. The young females have thin, pink to white tubular structures occupying about one-fifth of the portion of the body cavity. In adult females, eggs are readily discernable in the ovaries which increase in size and fill up most of the abdominal cavity (Bagenal, 1978; Halim and Guma'a, 1989). Sex ratio was calculated using the formula:

$$\text{Sex ratio} = \frac{\text{Number of males}}{\text{Number of females}}$$

2.5. Fulton's Condition Factor (K)

The condition factor (K) for each specimen was computed from

$$K = 100 / L^3 \quad (1)$$

Where, W is the observed body weight for each specimen, L is the observed standard length for each specimen and K is the condition factor.

2.6. The Length-Weight Relationship

Length-Weight relationship in *S. membranaceus* was represented by:

$$W = aL^b \quad (2)$$

Where b is an exponent usually between 2 and 4 according to Bagenal (1978). W is the observed total body weight, a is the intercept on the length axis and L is the observed standard length. The logarithmic transformation of equation 2 gives a straight line relationship

$$\text{Log } W = \text{Log } a + b \text{ Log } L \quad (3)$$

Log weight is plotted against log length, the regression coefficient is b, and log a is the intercept of the line on the Y-axis.

2.7. Determination of Food Items

After dissecting the fish, the stomachs were removed and weighed using a digital electronic weighing balance. The stomachs were weighed to the nearest 0.1 g and preserved in 4% formalin for subsequent examination.

Each stomach sample was slit open and emptied in a clean petridish and some food items were identified macroscopically. Three slides preparations for each stomach content was made and examined under a light Olympus Camera microscope model-CX31RTSF using X4, X10 and X40 objectives lens to identify and take photographs of some microscopic food items. The stomach contents of the specimens were analysed by:

i. Frequency of occurrence method

Frequency of occurrence (FO) of food items were calculated using the formula:

$$FO = \frac{\text{Number of stomachs with a food item}}{\text{Total number of non} - \text{empty stomachs}} X \frac{100}{1}$$

The values obtained were called percentage of occurrence of food items (% OFI).

ii. Numerical method

Different types of items in the stomach content of the fish species were calculated under numerical method (NM) using the formula:

$$NM = \frac{\text{Food item}}{\text{Total number of different food items}} X \frac{100}{1}$$

The values obtained were called percentage composition of food items (% CFI) by number (Bagenal, 1978).

iii. Point method

One hundred points were awarded to all the contents of a stomach and each food item was allotted with a number of points based on the macroscopic and microscopic judgments. All the points gained by a particular food item were expressed as a percentage of the total points scored by food items in the stomach samples thus point method (PM) was calculated using the formula:

$$PM = \frac{\text{Total points scored by a food item}}{\text{Total number of points of all food items}} X \frac{100}{1}$$

The values obtained were called percentage composition of food items by point method.

2.8. Determination of Stomach Vacuity Index

The stomachs were examinedmacroscopically and microscopically using three different slides preparations after they were slit opened to determine their emptiness or non-emptiness. Stomach vacuity index (SVI) was calculated using the formula:

$$SVI = \frac{\text{Number of empty stomachs X 100}}{\text{Total number of stomachs}} X \frac{100}{1}$$

The values obtained were called percentage of stomach vacuity index (% SVI).

3. Results

On the whole, male and female species of *S. membranaceus* from Lower Benue River from July, 2013 to June, 2014 had 50% abundance each. However, males were slightly more than the females in some months, and vice versa. The species were not available during themonths of February and March, 2014 (Table 2). The highest standard length in males (25.00cm) was observed in July, 2013 with a highest weight of 398.82g in the same month. On the other hand, the highest standard length in females (26.10cm) was observed in September, 2013 with a highest weight of 405.66g (Table 1). The relative condition factors of the species were observed to be higher in wet seasons compared withthe dry seasons. In males, the lowest K was observed in July, 2013 and January, 2014, while the highest K was observed in April, 2014. In females, the lowest and highest K was observed in August, 2014 (Figure 1). The logarithmic transformed length-weight relationship of male, female and combined sexes of *S. membranaceus* correlated positively and the correlation coefficients (r) were significant (Figure 2, 3 and 4). The stomach content analysis of *S. membranaceus* using the Frequency of Occurrence Method, the Point Method and the Numerical Method revealed that diatoms, surface water algae and insect parts were dominants food items consumed by the fish (Table 4, 5 and 6). On the other hand plant remains detritus, sand particles/mud and crustacean parts were the dominant food items using Frequency of Occurrence and Point Methods. The females' species of *S. membranaceus* had a higher stomach vacuity index than the males' species in July, 2013 and in September, 2013. A zero per cent stomach vacuity index was observed in females in August, 2013 while a higher stomach vacuity indices of both males and females was zero per cent in October, 2013, November, 2013, December, 2013, January, 2014, April, 2014, May, 2014 and June, 2014 (Table 7).

Table 1. *Sex distribution and standard length (SL) range of S. membranaceus in the Lower Benue River from July, 2013 to June, 2014.*

Month	Sex	No.	WT (g)	SL (cm)
July, 2013	M	27	52.42-398.82	12.30-25.00
	F	17	69.61-379.89	14.43-24.90
August, 2013	M	22	42.30-289.32	11.60-23.20
	F	25	63.08-309.46	13.70-24.50
September, 2013	M	12	107.50-191.52	13.60-20.00
	F	15	77.25-405.66	14.90-26.10
October, 2013	M	1	0.00-118.42	0.00-16.40
	F	1	0.00-282.71	0.00-22.40
November, 2013	M	2	8.67-9.78	7.20-7.60
	F	2	14.92-111.36	8.80-17.10
December, 2013	M	1	0.00-8.67	0.00-7.10
	F	-	_	-

Month	Sex	No.	WT (g)	SL (cm)
January, 2014	M	1	0.00-6.85	0.00-7.20
	F	-	_	-
April, 2014	M	14	17.13-256.18	5.10-21.10
	F	17	83.50-219.05	13.90-20.00
May, 2014	M	12	89.70-112.40	15.50-17.10
	F	13	80.30-115.80	15.40-17.60
June, 2014	M	9	103.70-230.12	15.90-24.00
	F	11	108.80-240.68	15.90-21.30

Table 2. *Sex ratio and percentage abundance of Synodontis membranaceus in the Lower Benue River.*

Months	M	F	Total	Sex Ratio (M:F)	Percentage (%) abundance		
					M	F	Combined
July, 2013	27	17	44	1.6:1	13.37	8.42	21.78
August, 2013	22	25	47	1:1.1	10.89	12.38	23.27
September, 2013	12	15	27	1:1.3	5.94	7.43	13.37
October, 2013	1	1	2	1:1	0.50	0.50	1.00
November, 2013	2	2	4	1:1	0.99	0.99	1.98
December, 2013	1	0	1	1:0	0.5	-	0.50
January, 2014	1	0	1	1:0	0.5	-	0.5
February, 2014	-	-	-	-	-	-	-
March, 2014	-	-	-	-	-	-	-
April, 2014	14	17	31	1:1.2	6.93	8.42	15.35
May, 2014	12	13	25	1:1.1	5.94	6.44	12.38
June, 2014	9	11	20	1:1.2	4.46	5.45	9.90
Total	101	101	202	1:1	50.00	50.00	100.00

Table 3. *Monthly variation in condition factor, a, b and r values of Synodontis membranaceus from July, 2013 to June, 2014.*

Month	Sex	No.	K range	a	b	r
	M	27	1.81-2.82	-1.45	2.87	0.98
July, 2013	F	17	2.19-2.65	-1.55	2.95	1.00
	Combined	44	1.81-2.82	-1.49	2.90	0.99
	M	22	1.88-3.36	-1.15	2.61	0.97
August, 2013	F	25	1.83-3.14	-1.29	2.74	0.98
	Combined	47	1.88-3.36	-1.27	2.72	0.98
	M	12	2.12-3.02	-0.76	2.33	0.95
September, 2013	F	15	2.13-2.75	0.67	1.27	0.69
	Combined	27	2.12-3.02	0.26	1.53	0.73
	M	1	0.00-2.52	_	_	_
October, 2013	F	1	0.00-2.68	_	_	_
	Combined	2	0.00-2.68	_	_	_
	M	2	2.23-2.32	-0.99	2.25	1.00
November, 2013	F	2	2.19-2.23	-1.63	3.03	1.00
	Combined	4	2.19-2.32	-1.68	2.98	1.00
	M	1	0.00-2.42	_	_	_
December, 2013	F	_	_	_	_	_
	Combined	1	0.00-2.42	_	_	_
	M	1	0.00-1.81	_	_	_
January, 2014	F	0	_	_	_	_
	Combined	1	0.00-1.81	_	_	_
	M	14	2.20-3.05	-0.52	2.09	0.95
April, 2014	F	17	2.32-3.13	-1.46	2.89	0.95
	Combined	31	2.20-3.05	-0.58	2.15	0.95
	M	12	2.03-2.51	-0.16	1.77	0.69
May, 2014	F	13	2.03-2.41	-063	2.16	0.89
	Combined	25	2.03-2.51	-0.57	2.11	0.84
	M	9	2.20-2.58	-1.26	2.72	0.99
June, 2014	F	11	2.27-2.76	-1.24	2.72	0.96
	Combined	20	2.20-2.76	-1.22	2.69	0.98

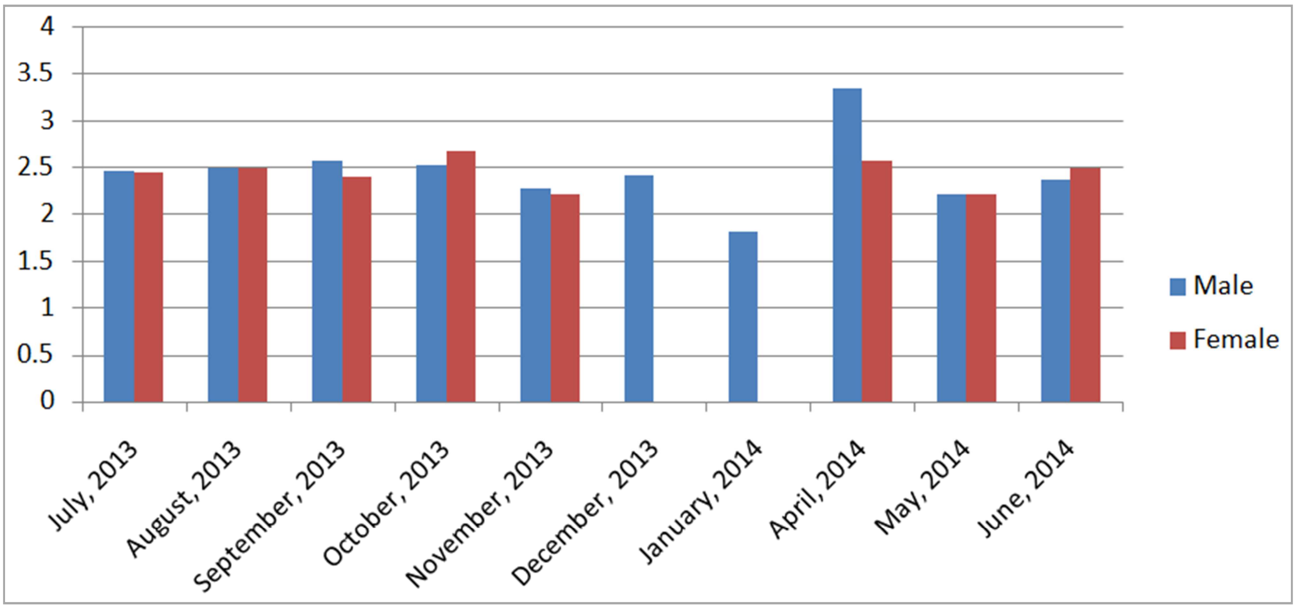

Fig. 1. *Mean monthly condition factor of S. membranaceus from lower Benue River.*

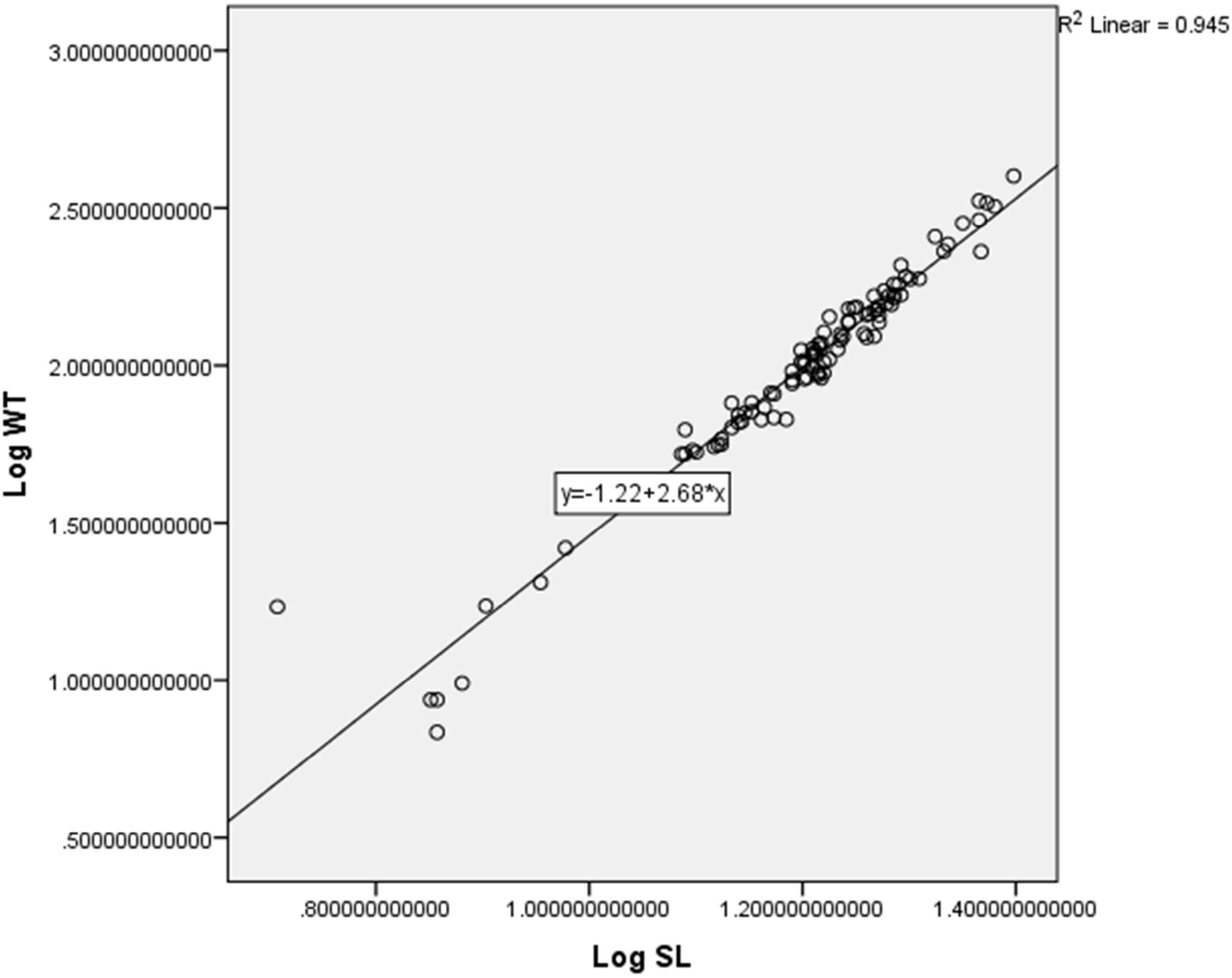

Fig. 2. *Length-weight relationship of S. membranaceus (male).*

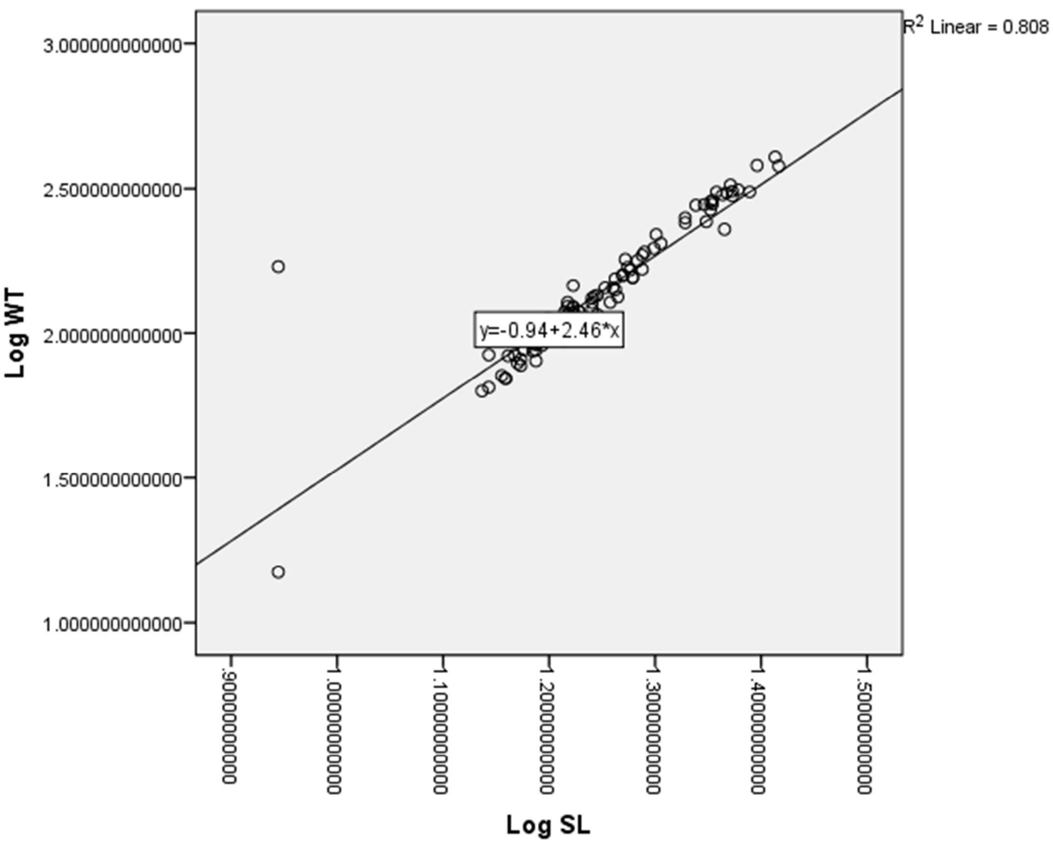

Fig. 3. *Length-weight relationship of S. membranaceus (female).*

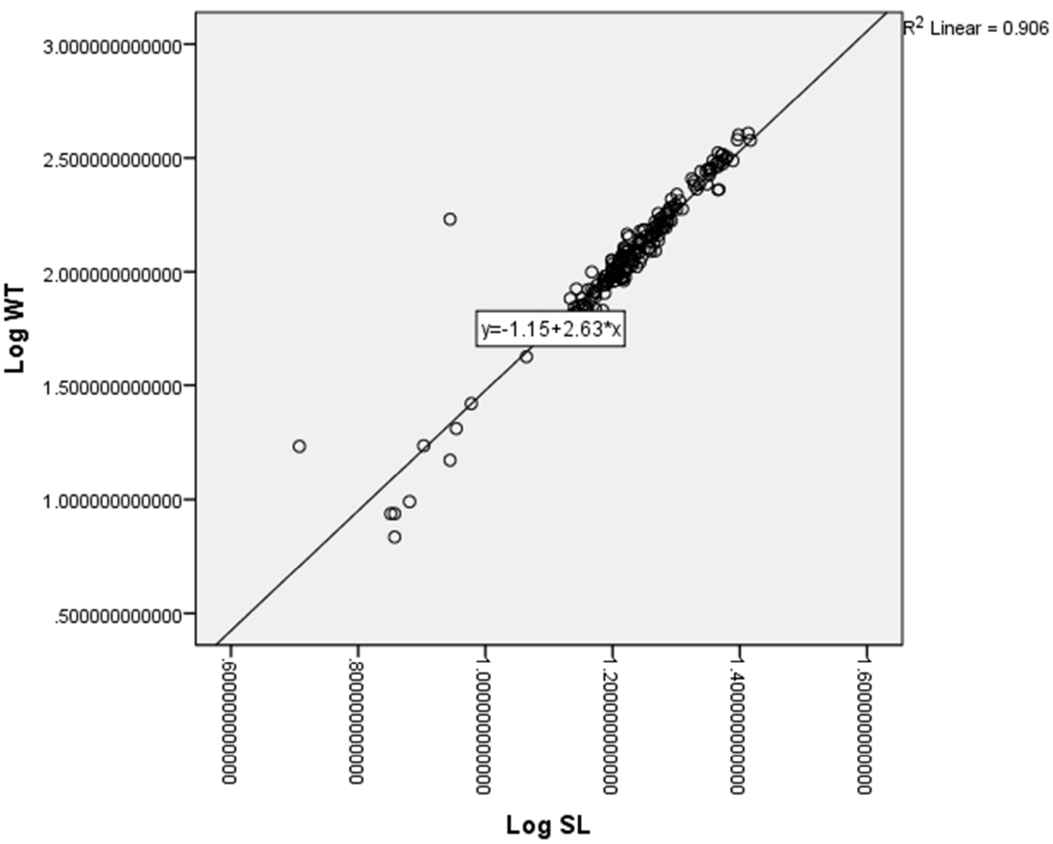

Fig. 4. *Length-weight relationship of S. membranaceus (combined).*

Table 4. *Stomach content of S. membranaceus in the lower Benue River using frequency of occurrence Method.*

Food item	Jul., 2013	Aug., 2013	Sept., 2013	Oct., 2013	Nov., 2013	Dec., 2013	Jan., 2014	Apr., 2014	May, 2014	Jun., 2014
PLANT										
Plant remains	94.87	68.29	70.83	50.00	50.00	100.00	100.00	67.74	48.00	80.00
Artificial meal	79.49	31.71	37.50	50.00	25.00	100.00	_	9.68	_	_
Millet	2.56	_	_	_	_	_	_	_	_	_
Maize	5.13	_	_	_	_	_	_	3.23	_	_
ALGAE										
Diatoms	87.81	80.49	87.50	100.00	100.00	100.00	100.00	87.10	80.00	65.00
Surface water algae	15.38	70.73	70.83	50.00	75.00	_	100.00	70.97	92.00	100.00
Pigmented flagellates	10.26	_	4.17	_	_	_	_	_	_	55.00
Filamentous algae	35.90	7.32	_	_	_	_	_	_	76.00	55.00
Blue green algae	_	_	_	_	_	_	_	_	12.00	35.00
INSECTS										
Insect larvae	64.10	7.76	12.50	50.00	75.00	_	_	35.48	4.00	_
Insect parts	71.79	68.29	91.67	50.00	75.00	100.00	100.00	54.85	36.00	5.00
MOLLUSCS										
Bivalves	2.56	4.88	4.17	_	25.00	100.00	_	_	_	_
CRUSTACEANS										
Crustacean parts	51.28	53.66	58.33	50.00	25.00	100.00	_	35.48	32.00	55.00
Crustacean eggs	_	_	_	_	_	_	_	9.68	24.00	5.00
PROTOZOA										
Paramecia	_	_	_	_	_	_	_	3.23	12.00	15.00
Amoebae	_	_	_	_	_	_	_	_	_	_
ROTIFERS										
Rotifer parts	7.69	9.76	8.33	_	_	_	_	3.23	32.00	70.00
WORMS										
Round worms	76.92	73.17	25.00	_	_	_	_	16.31	8.00	10.00
Detritus	71.79	92.68	91.67	100.00	100.00	100.00	100.00	74.19	52.00	80.00
Sand particles/mud	89.74	70.73	45.83	100.00	75.00	100.00	_	54.84	8.00	15.00
Polythene	_	_	_	_	_	_	_	3.23	_	_
Unidentified items	82.05	85.36	41.67	100.00	100.00	_	100.00	74.19	92.00	75.00

Table 5. *Stomach content of S. membranaceus in Lower Benue River using Numerical Method.*

Food item	Jul., 2013	Aug., 2013	Sept., 2013	Oct., 2013	Nov., 2013	Dec., 2013	Jan., 2014	Apr., 2014	May, 2014	Jun., 2014
PLANT										
Grains	0.63	_	_	_	_	_	_	0.44	_	_
Plant remains	*	*	*	*	*	*	*	*	*	*
Artificial meal	*	*	*	*	*	*	*	*	*	*
ALGAE										
Diatoms	27.22	21.22	31.75	25.00	18.18	40.00	22.22	27.31	16.42	11.99
Surface water algae	4.11	16.72	22.22	12.50	12.12	_	22.22	24.23	28.44	37.83
Pigmented flagellates	_	_	_	_	_	_	_	_	_	6.74
Filamentous algae	6.01	1.61	_	_	_	_	_	_	9.28	4.49
Blue green algae	_	_	_	_	_	_	_	_	0.90	2.62
INSECTS										
Insect larvae	8.86	1.29	2.38	6.25	9.09	_	_	4.85	0.30	_
Insect parts	9.81	10.29	18.25	6.25	9.09	40.00	11.11	8.37	2.69	0.37
MOLLUSCS										
Bivalves	0.32	0.64	0.79	_	3.03	20.00	_	_	_	_
CRUTACEANS										
Crustacean parts	*	*	*	*	*	*	*	*	*	*
Crustacean eggs	*	*	*	*	*	*	*	*	*	*
PROTOZOA										
Paramecia	_	_	_	_	_	_	_	0.44	0.90	_
Amoebae	_	_	_	_	_	_	_	_	_	1.12
ROTIFERS										
Rotifers parts	1.58	1.61	1.59	_	_	_	_	0.44	2.40	5.24
WORMS										
Round worms	10.13	11.58	5.56	_	_	_	_	2.20	0.60	0.75
Detritus	*	*	*	*	*	*	*	*	*	*
Sand particles/mud	*	*	*	*	*	*	*	*	*	*
Polythene	_	_	_	_	_	_	_	0.44	_	_
Unidentified items	29.43	35.05	17.46	50.00	48.48	_	44.22	29.96	36.23	28.46

*Undeterminable using this method.

Table 6. *Stomach content of S. membranaceus in the Lower Benue River using Point Method.*

Food item	Jul., 2013	Aug., 2013	Sept., 2013	Oct., 2013	Nov., 2013	Dec., 2013	Jan., 2014	Apr., 2014	May, 2014	Jun., 2014
PLANT										
Plant remains	13.61	10.33	11.70	7.50	7.50	15.00	15.00	12.66	6.90	10.89
Artificial meal	7.33	4.50	6.89	10.00	3.75	15.00	_	1.76	_	_
Millet	0.25	_	_	_	_	_	_	_	_	_
Maize	0.35	_	_	_	_	_	_	0.32	_	_
ALGAE										
Diatoms	15.30	13.64	17.34	15.00	15.00	10.00	25.00	18.11	13.81	9.90
Surface wateralgae	2.20	10.96	9.82	7.50	10.00	_	15.00	13.14	19.72	18.32
Pigmented flagellates	0.96	_	0.42	_	_	_	_	_	_	7.18
Filamentous algae	4.18	1.27	_	_	_	_	_	_	13.61	9.65
Blue green algae	_	_	_	_	_	_	_	_	1.18	3.22
INSECTS										
Insect larvae	6.29	0.99	1.67	7.50	10.00	_	_	4.81	0.39	_
Insect parts	7.67	7.84	13.16	7.50	10.00	10.00	10.00	6.89	4.54	0.50
MOLLUSCS										
Bivalves	0.25	0.38	0.42	_	2.50	10.00	_	_	_	_
CRUSTACEANS										
Crustacean parts	4.85	5.77	8.15	7.50	2.50	15.00	_	4.49	3.35	6.19
Crustacean eggs	_	_	_	_	_	_	_	1.12	2.37	0.50
PROTOZOA										
Paramecia	_	_	_	_	_	_	_	0.32	1.18	_
Amoebae	_	_	_	_	_	_	_	0.36	3.16	6.93
ROTIFERS										
Rotifer parts	0.69	1.02	0.84	_	_	_	_	0.32	3.16	6.93
WORMS										
Round worms	7.20	7.94	2.51	_	_	_	_	1.60	0.79	0.74
Detritus	6.56	16.23	17.50	17.50	17.50	15.00	25.00	17.95	9.07	12.87
Sand particles/mud	8.42	7.61	4.59	10.00	7.50	10.00	_	5.45	0.79	2.97
Polythene	_	_	_	_	_	_	_	0.16	_	_
Unidentified items	13.89	13.30	5.01	7.50	13.75	_	10.00	10.90	19.13	9.41

Table 7. *Stomach vacuity index of males and females of S. membranaceus in the Lower Benue River from July, 2013 to June, 2014.*

Month	Total	TSEM	ESM	TSEF	ESF	SVIM (%)	SVIF (%)
July, 2013	44	27	2	17	3	7.41	17.65
August, 2013	47	22	6	25	0	27.27	0
September, 2013	27	12	1	15	2	8.33	13.33
October, 2013	2	1	_	1	_	0	0
November, 2013	4	2	_	2	_	0	0
December, 2013	1	1	_	_	_	0	_
January, 2014	1	1	_	_	_	0	_
February, 2014	_	_	_	_	_	_	_
March, 2014	_	_	_	_	_	_	_
April, 2014	31	14	_	17	_	0	0
May, 2014	25	12	_	13	_	0	0
June, 2014	20	9	_	11	_	0	0

TSEM=Total stomach examined in males, ESM=Empty stomach in males, TSEF=Total stomach examined in females, ESF=Empty stomach in females, SVIM=Stmach vacuity index in males and SVIF=Stomach vacuity index in females

4. Discussion

The length-weight relationships of the males, females and combined sexes of *S. membranaceus* were highly significantly correlated ($P<0.01$) with high positive correlation coefficient (r). The values of regression coefficient (b) observed in this study were significantly below 2.99, which indicated that both male and female species of *S. membranaceus* exhibited negative allometric growth pattern. The b values of 2.2749, 2.2915 and 2.2863 were observed for male, female and combined sexes of *S. schall* respectivelyin River Nile at Gizza, Egypt (Midhat *et al.,* 2012). The observations in this study are also in agreement withfour species of *Synodontis* in Lower Benue River, (Akombo et al 2011); for *S. schall* in River Nile at Assiut (Hassan 2007); and *S. nigrita* in Ouèmè River Benin (Lalèyè *et al.,* 2006).

S. membranaceus had equal number of males and females on the whole during the study period. However, they were varied number of males and females in some months. Equal availability of males and females on the whole and as well as none availability of fish in February and March, 2014 could be attributed to the type of gears used, length of sampling period, time of sampling, seasonal changes, food availability, changes in water quality and the migration of the fish to shoals due to reduction in water level.

According to Khallaf and Authman (2010), sex ratio in fishes varied from one species to another. Nieto-Navarro *et al.,* (2010) concluded that the differences in observations could be due to seasonal variability of the environment, food availability, and sample size and length interval within different areas or habitat suitability. Akombo *et al.,* (2011) observed that *S. membranaceus* had more females than males with the male to female sex ratio of 1:1.6 and were not found in March, April and October, 2009 while *S. schall* had the sex ratio of 1.1:1.1 and were found throughout the sampling period. Midhat (2012) reported that the number of males of *S. schall* exceeded that of the females with the sex ratio of 1.2:1.

The lower and the higher values of mean condition factor (k) recorded for males of *S. membranaceus* implies that they could survive better even when biotic and abiotic factors are less favourable (Akombo *et al.,* 2011). Abowei (2009) reported the condition factor of *Hemisynodontis membranaceus* in the freshwater Reaches of Lower Num River, Niger Delta to be 0.83-1.00. Midhat *et al.,* (2012) reported that the males of *S. schall* had better conditions (1.83) than females in River Nile at Gizza. The different values of mean k (1.81-3.35 for males and 2.21-2.68 for females) obtained in this study could be as a result of differences in gonadal maturation, increase or decrease in feeding activities, population changes possibly due to modifications in food resources (Akombo *et al.,* 2011), as well as the general well being of the individual fish species. *S. membranaceus* was in good condition as all the values of k for the males and females were within the recommended ranged of 2.9-4.8 for fresh water fishes (Bagenal and Tesch, 1978).

The stomach vacuity indices of *S. membranaceus* showed that both the males and the females were not highly selective in their feeding and were flexible in their diets in many months during the sampling period. However, the species sexes tended to select food in few months. This could be attributed to differences in their taste, size of the fish, variation in food availability, changes in weather conditions and habitat preferences by the fish. Akombo (2014) reported the highest vacuity index in *S. sorex* (83.33%) and the lowest in *S. batensoda* (0.00) in the lower Benue River, and attributed that species like *S. sorex*, *S. violaceus*, *S. clarias*, *S. courteti*, *S. filamentous*, *S. vemiculatus* and *S. nigrita* were not very common in the river because of high selectivity exhibited in their feeding habits and concluded that species like *S. schall*, *S. gambiensis* and *S. membranaceus* were more flexible in their diets and were more abundant.

Out of 202 stomachs of *S. membranaceus* examined for the food content analysis, 9 males (8.91%) and 5 females (4.95%) had empty stomachs while 91.09% of males and 95.05% of females contained varied quantities of food items. Results on stomach content as presented in Tables 5, 6 and 7 showed that specimens of *S. membranaceus* examined during the study period were omnivorous. Meye *et al.,* (2008) reported that *S. ocellifer* from River Adofi in Southern Nigeria fed on a wide spectrum of food items ranging from various types of algae, detritus, sand particles and mud indicating that the species exhibited omnivorous feeding. Akombo *et al.,* (2011) also made similar observations on four species of *Synodontis* in the Lower Benue River at Makurdi.

This study showed that there was abundance of food for this fish and the fish fed well both in the months of wet and dry seasons. The high diversity of the food composition in the stomachs of *S. membranaceus* indicated a wide adaptability to the food and feeding habit in the Lower Benue River in which they live. This is an important strategy for survival and an advantage over the fishes competing for a specific food item (Lalèyè *et al.,* 2006).

5. Conclusion

S. membranaceus in the Lower Benue River was found to be omnivorous, feeding on a wide variety of food items. The fish fed well during the months of wet and dry seasons.

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