International Scholars Journals

African Journal of Fisheries Science ISSN 2375-0715 Vol. 12 (7), pp. 001-007, July, 2024. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Exploring the Dynamics of Gillnet Fishing in the Lower Nun River: A Study of Selectivity, Seasonal, Tidal, and Photoperiod Effects

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Accepted 21 December, 2023

The fish species of the lower Nun River was sampled to determine gillnet selectivity and the effect of season, tide and photoperiod variation on the catch. A total of 11,156 specimens were caught belonging to 14 families consisting of 25 species. Gillnet selectivity was observed with a declining trend from the largest mesh size net of 15 mm (58%) in number and 59% by weight, 12 mm (33%) in number and 33% by weight with the least catch of about 9% by number and 8% by weight from the smallest (8 mm) net. In terms of seasonal variation, the rainy season catches were significantly higher (P< 0.05) than the dry season with relative abundance of 67 and 32% respectively. Tidal variation in the catches showed that catches were higher during the low tidal period (61%) than the high tide (39%). Significant photoperiod differences (P < 0.05) were observed with higher catches by day (58%) than by night.

Key words: Gillnet selectivity, seasonal, tidal, photoperiod, variation, Nun River.

INTRODUCTION

The fishery sector of Nigeria consists of the artisan, industrial and aquaculture. Divers fishing techniques include gillnets, cast nets, beach seines, lines, traps, fishing stakes, bag nets etc. Canoes are usually manned by one man or woman; they usually carry two, three or even more depending on the gear being used in artisan fishery. Whyte (1974) had reported on the uses of hook and lines, gillnets and cast nets as effective fishing methods in lakes and streams. They are also very operational in river fishing. Solarin and Kusemiju (2003) observed gillnet, as the most abundant fishing gear along the Lagos Lagoon constituting 23% of the small-scale fishers. According to Anon (2008), gillnets are the most popular fishing gear for subsistence fishing and makes up a substantial part of inland fisheries. Emmanuel et al. (2008) observed size selection of gillnets as being crucial to fisheries management in order to maximize a sustainable yield. Body form and presence of spines may cause discrimination among fish species. Makkhen Kheng (2008) observed that while fishes smaller than the mesh sizes pass through unhindered, those too large to push their heads through the meshes as far as their gills, are not likely to be firmly wedged thus may escape.

Ufodike et al. (1989) observed gillnet selectivity with increasing mesh sizes based on three species. While the 50 mm mesh size gillnet caught all the three species, the 65 and 150 mm caught only *Lates niloticus* which formed 99.14% by weight.

Chinda and Osuamkpe (1994) observed seasonal variation with higher catches in the wet season than the dry season as well as gear selectivity with gillnet recording the highest numerical fish catch. Koutrakis et al. (2000) observed seasonal variation with the highest species richness during the rainy season in May and September, with 16 and 14 species respectively, and the

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lowest during the dry season (January and February) with 2 and 3 species respectively. According to Nwadukwe (1995) some species in two habitats in the Lagos Lagoon showed seasonal variation in catch while some did not. Nwadukwe (op.cit) further observed Cichlidae as the most abundant in the canal and Mugilidae as the most abundant family in the Lagoon shores and that most of the species collected were generally small sized and sexually immature fish.

Nwosu and Holzlohner (2001) observed lunar and seasonal variation in Macrobrachium Fisheries of the Cross River State Estuary of South Eastern Nigeria. Ufodike et al. (1989), reported that most of the catches were made in the early hours (6.00 am) and at dusk (6.00 pm). There was relatively little or no catch in the afternoons (12.00 noon to 3.00 pm); it was further concluded that gill net technology, catch period/technique are essential in maximizing fish catches.

Artisan fishers (who fish mostly for subsistence) abound in the Nun River which is a tributary of the River Niger, thus contributing to the artisan fisheries of the Niger Delta. This study will provide vital data that would be beneficial to the fisher folk in strategizing gillnet related fishing activities especially in the Nun River.

MATERIALS AND METHODS

Study area

This study was carried out at the lower Nun River around Anyama Ijaw in Bayelsa State (Figure 1). The sampling area lay between latitude 4° 51' and 4° 54'N; longitude 6° 11'E and 6° 13'E. The concave bank in the study area is moderately steep sloppy with loamy bottom while the convex bank is relatively shallow and sandy. The tidal influence is very mild during the dry season. However, a slightly reversed flow occurs during the high tide at the peak of the dry season but during the high flood, there is a swift one directional current in the study area.

Sampling procedure

Sampling was carried out twice a month at two weeks interval for twelve (12) calendar months using three sets of gillnet with stretched mesh sizes of 8, 12 and 15 mm respectively each measuring 35 m in length and 3 m in depth with a surface area of 105 m^2. Sampling lasted for three (3) hours every sampling day. The three drift gillnets were operated simultaneously from 3 fishing canoes. Sampling was done horizontally and vertically that is, the concave, the central and convex sections of the river at the surface mid water and bottom. The float line and the weighted bottom line of the gillnets were adjusted to keep the net at the desired water depth.

Gillnet selectivity

Catches of the three different mesh size nets were landed separately. The total number of each species caught, was counted to determine species abundance and weighed using a digital top-loading balance and then preserved in 10% formalin solution in plastic containers. Fish specimens were identified using monographs, descriptions, checklist and keys (Nedham and Nedham, 1962; Reed et al., 1967; Holden and Reed, 1972; FAO, 1981; Leveque et al., 1991; Olaosebekan and Raji, 1998). Gillnet selectivity was determined from the differences in the totality of species, numbers and biomass caught by the various gillnets.

Seasonal variation

Seasonal variation was determined by comparing the total catch for each season. November to April represented the dry season while May to October represented the rainy season.

Tidal and photoperiod variation

Tidal and photoperiod variations were determined as the difference in total catch between low and high tidal levels and day and night respectively.

Data analysis

Analysis of variance (ANOVA) was used to test for significant difference of fish caught with the different mesh sizes of gillnets. Student's test was used to test for total and photoperiod differences in abundance. All analysis were carried out through the computer enhanced Microsoft Excel Programme.

RESULTS

Gillnet selectivity

A total of 25 species belonging to 14 families was observed. The Gillnet selectivity of the various mesh sizes are shown in Table 1.

15 mm mesh size net

A total of 6,504 specimens (58.30%) was observed in this gillnet such that it recorded 12 out of the 14 families. Schilbeidae constituted the best catch of 75.61% and biomass of 81.68%, followed by Clupeidae (13.82%) and biomass of 13.82% while the least catch of 0.02% consisted of Sphyraenidae. Carangidae and Anabantidae were not caught.

12 mm mesh size net

This net recorded 3,687 specimens contributing 33.0% of the total catch consisting 11 families with Schilbeidae as the highest (69.20%), while Clupeidae and Mormyridae formed 28.01 and 6.80% respectively. The least catches consisted of Carangidae, Characidae, Distichodontidae, Cyprinidae and Mormyridae. Elopidae, Mochokidae and Sphyraenidae were not caught.

8 mm mesh size net

The least catch by number of 968 (8.7%) occurred in this net with only 6 families with preponderance of Schilbeidae (62.0%) followed by Clupeidae (8.3%).

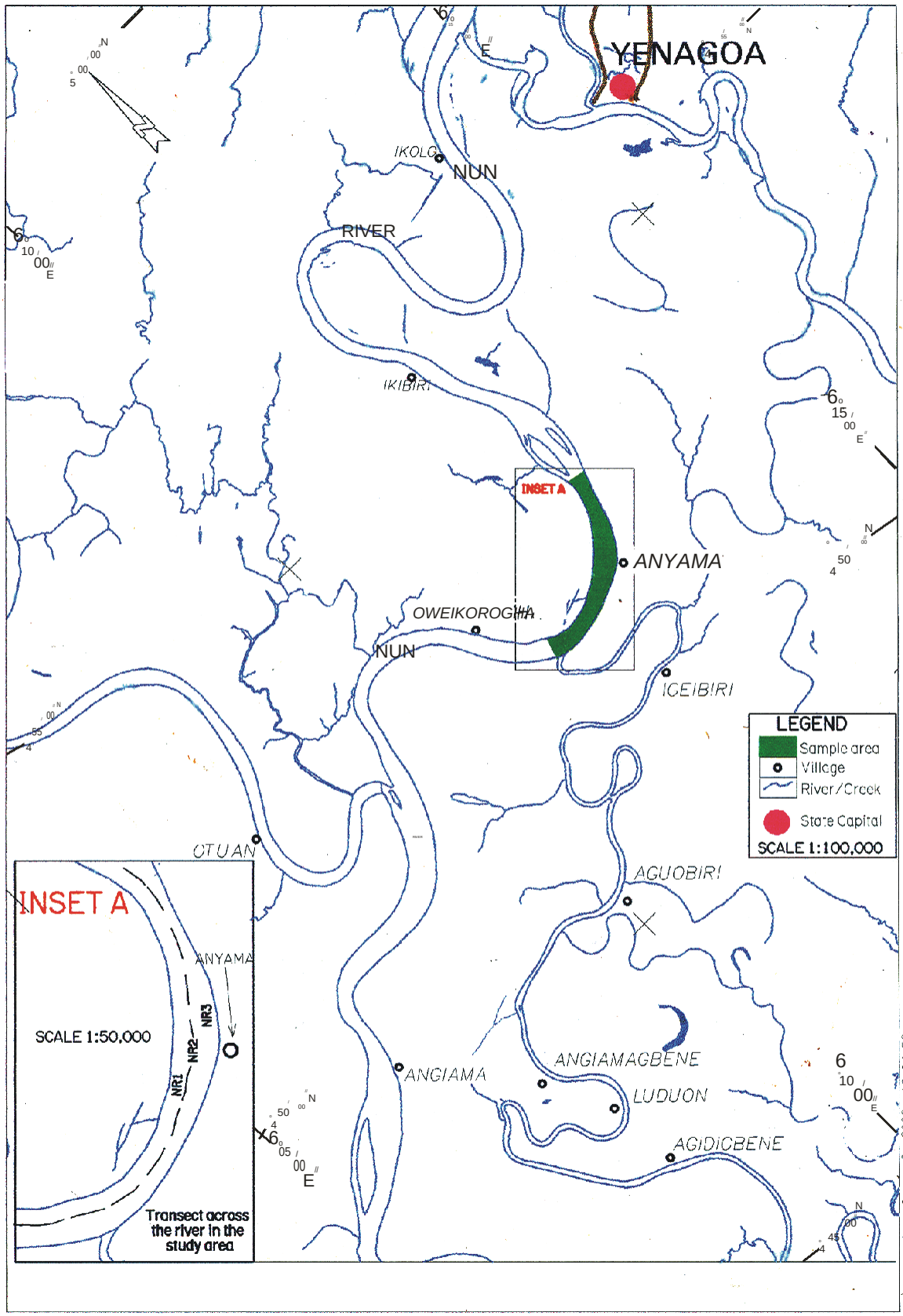

Figure 1. The lower Nun River, Niger Delta – showing the sample area and sampling stations (NR1 = Convex; NR2 = Middle; NR3 = Concave).

Table 1. Gillnet Selectivity in the lower Nun River.

S/N	Family/Species	15 mm				12 mm				8 mm			
		No.	%	Wt (g)	%	No.	%	Wt (g)	%	No.	%	Wt (g)	%
1	**Bagridae**												
	Chrisichthys nigrodigitatus	10	0.15	28	0.10	60	1.63	70	0.45	22	2.30	27	0.70
2	**Carangidae**												
	Caranx latus	0	0	0	0	3	0.08	7	0.04	0	0	0	0
3	**Characidae**												
	Brycinus macrolepidotus	*2*	*0.03*	*5*	*0.02*	*4*	*0.11*	*0*	*0*	*2*	*0.20*	*3*	*0.80*
	Brycinus longipinnis	*3*	*0.05*	*15*	*0.05*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Alestes macrolepidotus	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
	Rhabdalestes septentionalis	*0*	*0*	*0*	*0*	*1*	*0.03*	*5*	*0.03*	*0*	*0*	*0*	*0*
4	**Clupeidae**												
	Odaxothorissa mento	361	5.60	1800	6.48	322	8.73	1288	8.23	80	8.30	272	7.10
	Pellonula leonensis	1100	17.0	2040	7.34	711	19.28	1650	10.53	239	24.70	562	15.0
5	**Distichodontidae**												
	Distichodus rostratus	0	0	0	0	1	0.30	8	0.05	0	0	0	0
	Paradistichodus dimidiatus	2	0.03	6	0.02	1	0.30	2	0.01	0	0	0	0
6	**Cyprinidae**												
	Barbus callipterus	5	0.08	15	0.05	2	0.05	5	0.03	0	0	0	0
	Leptocypris niloticus	3	0.05	16	0.06	2	0.05	7	0.04	1	0.10	2	0.05
	Lebeo coubrie	1	0.20	4	0.01	2	0.05	8	0.05	0	0	0	0
7	**Schilbeidae**												
	Parailia pellucida	4850	74.6	17,887	64.32	2505	68.04	9435	60.20	600	62.0	2902	75.40
	Eutropius niloticus	68	1.04	4800	17.26	41	1.11	3111	20.05	6	0.09	0	0
	Eutropius buffei	6	0.09	19	0.07	1	0.03	2	0.01	0	0	0	0
	Siluranodon auritus	0	0	1	0.03	3	0.02	0	0	0	0	0	0
8	**Mormyridae**												
	Petrocephalus bane ansorgii	72	1.11	234	0.84	25	6.80	76	0.50	0	0	0	0
9	**Gobidae**												
	Chonophorus lateristriga	2	0.03	3	0.01	1	0.03	1	0.01	0	0	0	0
10	**Elopidae**												
	Elops lacerate	3	0.05	10	0.04	0	0	0	0	0	0	0	0
11	**Mochokidae**												
	Synodontis gambiensis	2	0.03	600	2.16	0	0	0	0	0	0	0	0
	Synodotis nigrita	1	0.02	240	0.86	0	0	0	0	0	0	0	0
12	**Anabantidae**												
	Ctenopoma kingsleyae	0	0	0	0	1	0.03	2	0.01	0	0	0	0
13	**Sphyraenadae**												
	Sphyraena afra	1	0.02	72	0.3	0	0	0	0	0	0	0	0
14	**Paeneidae**												
	Macrobrachium feliunum	12	0.20	17	0.06	5	0.14	6	0.04	12	1.25	15	0.40
Total		6,504		27,881		3,687		15,672		968		3,850	
Rel. %		58.3				33.0				8.70			

Others include Characidae, Cyprinidae, Bagridae and Paeneidae. Total catch was thus observed to increase with increasing mesh size. Statistically tested ANOVA revealed significant difference ($P < 0.05$) in the catch of the various mesh sizes used.

Seasonal variation in species abundance

The seasonal variation of the gillnet catches is shown in Table 2. A trend of significantly ($P<0.05$) higher catches in the rainy season (67.4%) than the dry season (32.6%)

Table 2. Seasonal variation in catch of Fish Families in the Lower Nun River.

S/N	Family	Dry season		Rainy season		Total catch
		No	%	No	%	
1	Bagridae	20	0.55	72	0.96	92
2	Carangidae	2	0.06	1	0.01	3
3	Characidae	4	0.12	11	0.15	15
4	Clupeidae	2,165	59.54	684	8.62	2,813
5	Distichodontidae	1	0.03	3	0.04	4
6	Cyprinidae	4	0.12	10	0.13	14
7	Schibeidae	1,405	38.64	6,673	88.74	78
8	Mormyridae	7	0.19	90	1.19	97
9	Gobidae	0	0	3	0.04	3
10	Elopidae	2	0.06	1	0.01	3
11	Mochokidae	0	0	3	0.04	3
12	Anabantidae	0	0	1	0.01	1
13	Sphyraenidae	1	0.03	0	0	1
14	Peaneidae	25	0.69	4	0.05	29
Total		**3,636**		**7,520**		**11,156**
Relative abundance (%)		**32.60**		**67,40**		

Table 3. Tidal variation in catch of Fish Families in the Lower Nun River.

S/N	Family	Low tide		High tide		Total catch
		No	%	No	%	
1	Bagridae	24	0.35	68	1.55	92
2	Carangidae	0	0	3	0.07	3
3	Characidae	8	0.12	7	0.16	15
4	Clupeidae	1,403	20.74	1,410	32.10	2,813
5	Distichodontidae	0	0	4	0.09	4
6	Cyprinidae	4	0.06	10	0.23	14
7	Schibeidae	5,295	78.28	2,783	63.37	8,078
8	Mormyridae	23	0.34	74	1.68	97
9	Gobidae	2	0.03	1	0.02	3
10	Elopidae	2	0.03	1	0.02	3
11	Mochokidae	1	0.06	1	0.02	2
12	Anabantidae	0	0	1	0.02	1
13	Sphyraenidae	0	0	1	0.02	1
14	Peaneidae	2	0.03	1	0.02	29
Total		**6,764**		**4,392**		**11,156**
Relative abundance (%)		**60.63**		**39.37**		

was observed. Schilbeidae was the most dominant in both seasons followed by Clupeidae and Bagridae. However, Clupeidae were more abundant in the dry season (59%) than the rainy season (8.62%).

Tidal variation in catch

The tidal variation of the gill net fishery in the lower Nun River is shown on Table 3. While 10 families were observed in the low tide catches, the entire 14 families occurred in the high tide. Schilbeidae was the most abundant in both the low tide (78.28%) and the high tide (63.37%). A relative abundance of 60.63% observed in the low tide was significantly different ($P<0.05$) from that of the high tide of 39.37%. Bagridae was however slightly more abundant in the high tide 68 (1.55%) than low tide 24 (0.35%).

Photoperiod variation in catch

This is shown on Table 4, indicating a relative abundance by day of 58.26% and night of 41.41%. A total of 12

Table 4. Photoperiod variation in catch of Fish Families in the Lower Nun River.

S/N	Family	Day		Night		Total catch
		Abundance	%	Abundance	%	
1	Bagridae	24	0.36	68	1.47	92
2	Carangidae	0	0	3	0.07	3
3	Characidae	8	0.12	7	0.15	15
4	Clupeidae	1,549	23.64	1,264	0.27	2,813
5	Distichodontidae	2	0.03	2	0.04	4
6	Cyprinidae	10	0.15	4	0.08	14
7	Schibeidae	4,904	75.02	3,174	68.72	8,078
8	Mormyridae	13	0.19	84	1.81	97
9	Gobidae	2	0.03	1	0.02	3
10	Elopidae	2	0.03	1	0.02	311
11	Mochokidae	1	0.01	1	0.02	2
12	Anabantidae	1	0.01	1	0.02	1
13	Sphyraenidae	0	0	1	0.02	1
14	Peaneidae	21	0.32	8	0.16	29
Total		**6,532**		**4,619**		**1,156**
Relative abundance (%)		**56.59**		**41.41**		

families were observed in the day while 14 occurred in the night catches. Schilbeidae consisted 75.02% by day and 68.72% by night in the catches. The least percentage occurrence came from Anabantidae (0.01%), Mockokidae (0.01%), Distichodontidae (0.03%) by day and Sphyraenidae (0.02%), Elopidae (0.02%), Gobidae (0.02%) and Distichodontidae (0.04%), Mockokidae (0.02%) by night.

DISCUSSION

Gillnet selectivity

The relative abundance of ichthyofuana observed, indicated that variation in mesh size, greatly influenced species diversity, and abundance in the lower Nun River. Large mesh size (15 mm) had the highest catch followed by the 12 mm mesh size and then the least (8 mm). More families appeared in the large mesh size and less in the small mesh size. This indicates that these mesh sizes are probably the best to fish for the species in the study area. Gillnet selectivity had been reported by Sikoki et al. (1998); Gear selectivity was also observed by Ufodike et al. (1989), Allison et al. (1997), and Kingdom and Allison (2007).

Apart from Schilbeidae and Clupeidae that had small sized sexually mature fish, the fishes caught in this study were small in size and generally immature due to the small mesh sizes of the gillnets used. This is an indication that smaller mesh sizes catch small and immature fishes. Nwadukwe (1995) also made similar observation in the Lagos lagoon.

The occurrence of specimens of *Elops lacerta* (Elopidae), which is a brackish water species, may be as a result of migration during the high tide when there was a reverse (upward) flow of the brackish water from the Atlantic Ocean into the fresh water and reaches the lower Nun River which is a distributary that discharges into it. Such species may strive in freshwater through adaptation.

Seasonal, tidal and photoperiod variation in catch

The seasonal variation with higher catches in the rainy season than the dry season is in agreement with Sikoki et al. (1998). A similar trend was observed in the lower Bonny River, Niger Delta (Chindah and Osuamkpe, 1994), Nwadukwe (1995) in the mangrove habitat in the Lagos Lagoon; and Nwosu and Holzlohner (2000) in Cross River State.

Tidal variation with higher catches in the low tide than the high tide observed is in agreement with Allison et al. (1997) in Elechi Creek. This may suggest a migratory pattern of the observed species in the study area. In addition, the occurrence of Carangidae, Distichodontidae Anabantidae, and Sphyraenidae only during the high tide may be an indication that even though tidal range in the freshwater environment is relatively small, it could affect species distribution and abundance. This observation is however contrary to Felix-Hackradt et al. (2010) with higher catch during the high than low tide. Macdonald and Lawrensen (2010) however did not observe any significant variation in catch due to tidal differences. The higher catches (58.26%) in the day than the night (41.74%) is similar with Allison et al. (1996) who observed 64.45% by day and 35.55% at night. This may

suggest feeding habit of most species in the study area. Emmanuel et al. (2008) also observed higher catches of 62% by day and 32% by night in the Lagos lagoon. Higher catches by day (58.6%) was also observed by Felix-Hackradt than night (41.4%) in the Portugal beach, Southern Brazil. Bahamon et al. (2009) observed that with an increase in sampling depth, the reactivity of species to day-night cycles is reduced due to reduced perceptions in light intensity.

Since passive gear tend to catch fish mostly during feeding, it meant that most species caught in this study probably fed during the day than at night. Olowo et al. (2004) made similar observation in *Brycinus sadleri* as actively foraging during the daylight hours and remained quiet during the night while Nile perch foraged more actively during the night than during the day. Nwosu and Holzloner (2001) also recorded lunar variation in Macrobrachium Fisheries in the Cross River State Estuary of South Eastern Nigeria.

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