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DIEL VARIATION IN FISH SPECIES COMPOSITION IN AGBURA RIVER, A TRIBUTARY OF THE LOWER NUN RIVER, NIGER-DELTA, NIGERIA

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ABSTRACT: The diel variation in the composition of fish species in Agbura River, a tributary of the lower Nun River was investigated. Fish samples were collected between April 2012 and March 2013 during day and night. Fish sampling was conducted monthly in three different stations of the river. Out of the 1,137 fish samples, a total of 677 (59.54%) and 460 (40.46%) individuals were caught during the day and night respectively. Of the 29 species, 9 were restricted to daytime catch only, while only 3 species were restricted to night catch. The remaining 17 species occurred during both day and night. The dominant daytime catch was *Synodontis budgetti* and *Synodontis batensoda,* while the dominant night catch included *Bagrus bayad macropterus.* The results of the study showed that the diel variations in fish species composition in Agbura River were related to the activity pattern of the fish during different times, as more fish were caught when active. This was discussed and compared with the findings of earlier studies conducted in different water bodies in the Niger Delta and elsewhere.

Keywords: Diel variation, Fish species, Agbura River, Nigeria

Introduction

Man through the collective effects of unrestrained exploitation of the aquatic resources, excessive water withdrawal and the haphazard discharge of effluents of both domestic and industrial origin has continued to threaten and subsequently reduce the tremendous fish diversities and abundance. Other factors that reduce freshwater biodiversity include the invasion of non-native species and the mismanagement of inland fisheries. Today, an estimated 20% of the world's freshwater fish is susceptible, rare or extinct (Cantonati *et al*, 2020). Population increase coupled with technological development in agriculture and industrial practices bring about the introduction of various substances into the aquatic ecosystem which acts as the ultimate sink for most compounds (Tijani *et al*., 2013). It has also led to the total migration of some species from areas where they originally inhabited to an entirely strange habitat. In others, it has resulted in a drastic reduction of affected species within the territory or complete extinction of some species. Fish communities of tropical rivers react to all environmental changes caused by human interruption (Arantes *et al* ., 2019).

The Niger Delta contributes more than 50% of the entire domestic Nigerian fish supply, being blessed with an abundance of both fresh, brackish and marine water bodies that are inhabited by a collection of both fin fish and non-fish fauna that help to buttress artisanal fisheries (Akankali *and* Jamabo, 2011). Knowledge of fish biology including species composition of different water bodies is important to enhance the management and proper use of the water resources. Studies in some freshwater bodies in southern Nigeria have shown that environmental alteration and other human activities influence species diversity and abundance (Arimoro *and* Keke, 2017).

The main objective of fisheries management, conservation and regulation is to ensure long-term viability through sustainable operations of the fisheries resources. Knowing how the species is distributed in freshwater can help determine whether a fish species is pelagic or demersal, which can help determine the type of fishing equipment to use (Adewumi *et al*., 2015). The information on habitat and abundance, amongst others, are very vital for fisheries development and management (Lindeman *et al*., 2000). The description of the fish community of the water body is important for consideration, not only the spatial, but also the diversity of fish species as well, because such knowledge can enhance the management of water resources (Luo *et al*., 2023).

With the decline in fish population as a result of water pollution and damming of streams and rivers as well as overfishing, the need to begin in-depth studies on variations of fish communities and their management for sustainable productivity has become desirable and persuasive. The inhabitants of the Niger Delta area of Nigeria surrounded by numerous rivers and creeks consume fish caught from these waterways as the cheapest and most reliable source of animal protein. Ikomi *et al.,* (2005) also reported that the cichlid *Thysia ansorgii* occurred throughout the year in the Ethiope River appearing more in vegetated areas. It occurred more in the daytime than at night.

Idodo-Umeh, (2003) in his study of fishes in River Ase, reported that out of the 100 fish species caught in the river, 91 fish species were captured during the day while 70 fish species were captured during the night. More fish species were captured between 0600 and 0900h accounting for 1,229 out of the 4,226 individuals of all fish captured than at other time intervals. A total of 2,669 (63.20%) and 1,557 (36.80%) individuals were caught during the day and night respectively. He observed that more fish were caught at the time of the activities of the fish. *Citharinus citharus* and *Chrysichthys nigrodigitatus* which were the two most dominant species appear to be active during the day. He also reported that some species such as

Synodontis schall, *Hydrocyanus forskalli*, *Chrysichthys auratus longifilis*, and *Hemisynodontis* were more active during the day while others were more active during the night. However, some other species such as *Labeo senegalensis*, *Eutropius niloticus*, *Schilbe mystus* and *Pellucida afzelius* were not restricted to day or night catch.

Agbura River, which is a tributary of the Nun River, is one of the numerous water bodies that crisscross the Niger Delta region. Some studies have been conducted on the fish and fisheries ecology of this river, but studies on the diel variation in the Fish species composition are sparse.

This present study therefore aimed at providing information on the diel distribution of fish species collection of the Agbura River for proper management, conservation and regulation to ensure long-term viability through sustainable operations of the fisheries resources.

Materials and methods

Description of the study area

Agbura River, a tributary of the Lower Nun River in Yenagoa Local Government of Bayelsa State, Niger-Delta, Nigeria lies between Lat. N4 ° 50'43'' and Long. E6°15'59'' with a total area of 2400km^2 (Fig. 3.1).

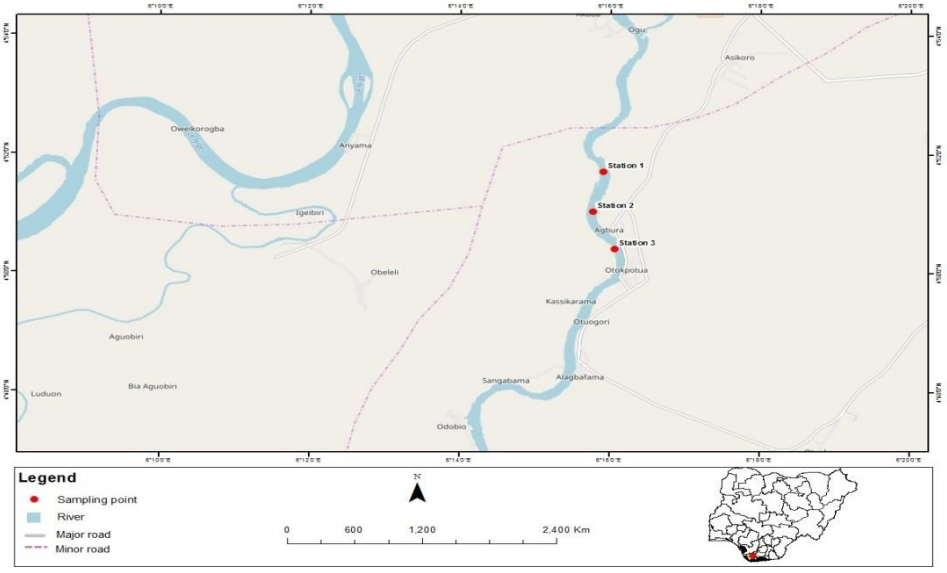

Fig: 1: Map of Nigeria, the Study Area and sampling points/locations

The Nun River is considered the direct extension of the Niger River after the Niger River separates into the Nun and Forcados Rivers about 20 miles (32 km) downstream from Aboh (Gijo and Alagoa, 2022). The Nun River flows through scantily settled zones of freshwater and mangrove swamps and coastal sand ridges before completing its 100-mile (160km) south.

The study area has tropical climatic conditions with two definite seasons; wet and dry seasons. The wet season is from May to October while the dry season is from November to April. The mean annual rainfall (219.58mm $\pm$ 46.31), relative humidity (68.08% $\pm$ 4.32) as well as the mean temperature (29.14°C $\pm$0.588)

of the study area was collected from the Nigeria Meteorological Agency (NIMETA) in Port Harcourt which serves both Rivers and Bayelsa States. The vegetation of the study area consists of mostly tall trees including oil palm trees (*Elaeis guineensis*). The inhabitants are mainly farmers, fishermen as well as palm wine tappers.

The river experiences tidal pressure in the dry season. During the rainy season, the river overflows its bank and flooding occurs. In 2012, heavy flooding which cut across many states in Nigeria, especially in the Niger Delta region also affected the study area. The flood left many homes swamped with the consequential loss of property and human lives.

In this research work, three sampling points were chosen along the river. The choice was centred on vegetation (Station I), the location of human settlement, (Station II) and the suction dredging site (Station III) of the river (Plates 3.1-3.3).

PLATE 3.1: STATION 1

PLATE 3.2: STATION 2

PLATE 3.3: STATION 3

Sampling techniques

Sampling was designed to be carried out monthly for twelve months (April 2012 to March 2013) with the aid of hired fishermen. Day and night sampling for fish from the three stations was done respectively using four methods: dragnets, hand net, traditional trap and hook and line.

Physical parameters of the water such as Air and Water Temperature (ºC), Flow velocity (m/s), Water depth (m) and Transparency were determined in situ in the field while water samples for chemical analysis were collected in 2 litres containers and kept in an ice chest and then transported to the laboratory for storage in the deep freezer before laboratory analysis. All water Samples were collected between 0830hrs and 1230hrs local time.

Fish preservation

All specimens collected in the field were preserved immediately in 10% formalin solution and labelled according to the date and station of collection. In the laboratory, the specimens were sorted, identified, counted and labelled in appropriate containers.

Fish identification

The fishes are identified using the taxonomic keys by Idodo-Umeh, (2003) and Olaosebikan and Raji, (2013) to species level.

Data analysis

The chi-square test (X^2) ($P<0.05$) was used to test for significant differences between the fish abundance in day and night samples. All statistical procedures for the data analysis were adopted from Ogbeibu (2005).

Result

The variation in the day and night catches for the individual species in Agbura River during the period of study is presented in Table 1 Out of the 1,137 fish samples, a total of 677 (59.54%) and 460

(40.46%) individuals were caught during the day and night respectively. Of the 29 species, 9 were restricted to daytime catch only (*Heterotis niloticus, Pantodon bucholzi, Parailia pellucida, Schilbe mystus, Synodontis ocellifer, Parachanna Africana, Lates niloticus, Ctenopoma petherici and Polycentropsis abbreviata*), while only 3 species was restricted to night catch (*Erpetoichthys calabaricus, Xenomystus nigri and Parachanna obscura*). The remaining 17 species occurred during both day and night. The dominant daytime catch were *Synodontis budgetti* and *Synodontis batensoda*, while the dominant night catch included *Bagrus bayad macropterus*. The tables show a general trend of more catches in the daytime for most species than the night catches.

Table 1: Diel variation in Fish abundance in Agbura River, Niger-Delta Nigeria from April 2012 to March 2013

S/N	Fish species	Total N	Day n_1	%	Night n_2	%
1	*Erpetoichthys calabaricus*	01	-	-	01	0.22
2	*Heterotis niloticus*	05	05	0.74	-	-
3	*Pantodon bucholzi*	32	32	4.73	-	-
4	*Xenomystus nigri*	08	-	-	08	1.74
5	*Gnathonemus abadii*	55	17	2.51	38	8.26
6	*Mormyrus rume*	61	38	5.61	23	5.00
7	*Marcusenius psittacus*	44	13	1.92	31	6.74
8	*Gnathonemus tamandua*	82	60	8.86	22	4.78
9	*Citharinus citharus*	12	06	0.89	06	1.30
10	*Auchenoglanis aluuensis*	10	05	0.74	05	1.09
11	*Bagrus bayad macropterus*	93	35	5.17	58	12.61
12	*Chrysichthys nigrodigitatus*	13	05	0.74	08	1.74
13	*Auchenoglanis biscutatus*	50	16	2.36	34	7.39
14	*Parailia pellucida*	04	04	0.59	-	-
15	*Schilbe mystus*	27	27	3.99	-	-
16	*Clarias anguillaris*	26	10	1.48	16	3.48
17	*Clarias gariepinus*	24	11	1.62	13	2.83
18	*Synodontis budgetti*	180	110	16.25	70	15.22
19	*Synodontis batensoda*	95	73	10.78	22	4.78
20	*Synodontis ocellifer*	41	41	6.06	-	-
21	*Parachanna obscura*	05	-	-	05	1.09
22	*Parachanna africana*	09	09	1.33	-	-
23	*Lates niloticus*	13	13	1.92	-	-
24	*Oreochromis niloticus*	72	40	5.91	32	6.96
25	*Hemichromis fasciatus*	33	20	2.95	13	2.83
26	*Tilapia zilli*	54	34	5.02	20	4.35
27	*Sarotherodon galilaeus*	68	33	4.87	35	7.61
28	*Ctenopoma petherici*	11	11	1.62	-	-
29	*Polycentropsis abbreviata*	09	09	1.33	-	-
	TOTAL	**1137**	**677**	**100**	**460**	**100**

The diel variations in catch among the individual species in the four dominant families are presented in Table 2 and the occurrences are discussed below.

Table 2: Variation in the day and night catches of major fish families/species in Agbura River

FISH FAMILIES/SPECIES	DAY	NIGHT	X^2 (P<0.05)
MORMYRIDAE			
Gnathonemus abadii	17	38	7.69*
Mormyrus rume	38	23	2.77
Marcusenius psittacus	13	31	3.19*
Gnathonemus tamandua	60	22	6.44*
TOTAL	**128**	**114**	
BAGRIDAE			
Auchenoglanis aluuensis	05	05	0.01
Bagrus bayad macropterus	35	58	7.64
Chrysichthys nigrodigitatus	05	08	1.39
Auchenoglanis biscutatus	16	34	7.69*
TOTAL	**61**	**105**	
MOCHOKIDAE			
Synodontis budgetti	110	70	13.89*
Synodontis batensoda	73	22	18.58*
Synodontis ocellifer	41	-	-
TOTAL	**224**	**92**	
CICHLIDAE			
Oreochromis niloticus	40	32	6.82
Hemichromis fasciatus	20	13	0.43
Tilapia zilli	34	20	4.00
Sarotherodon galilaeus	33	35	0.78
TOTAL	**127**	**100**	

***** Indicates significance

Mormyridae

Gnathonemus tamandua had a total of 60 individuals (73.17%) in the daytime catch and 22 individuals (26.83%) in the night**.** The daytime catches were also significantly higher (X^2=6.44, P<0.05) than the daytime catches.

Out of a total of 119 individuals of *Mormyrus rume* caught in this study, 38 or 62.30% were recorded in the night while 23 or 37.70% individuals occurred in the daytime catch. The chi-square test shows no significant difference (P<0.05) between the abundance of this species in day and night time.

Bagridae

Out of a total of 93 individuals of *Bagrus bayad macropterus* caught during the study period, 35 or 37.63% was recorded in the day while 58 or 62.37% was recorded in the night. The chi-square test showed no significant difference (P<0.05) between the day and night records.

For *Auchenoglanis biscutatus* 16 or 32% individuals were recorded during the day while 34 individuals representing 68% were caught in the night. The daytime catch was statistically very different (P<0.05) from the nighttime catch.

Mochokidae

Synodontis budgetti recorded 110 individuals representing 61.11% in the daytime and 70 or 38.89% in the night. The chi-square test carried out showed a significant difference ($P<0.05$) between the day and night catches.

Synodontis batensoda had 73 individuals or 76.84% caught during the day while 22 individuals or 23.16% were recorded the night**.** The daytime catches were also significantly higher ($P<0.05$) than the nighttime catches.

Cichlidae

A total of 72 individuals of *Oreochromis niloticus* were caught, 40 or 55.56% were recorded in the day while the remaining 32 or 44.46% were caught at night. The daytime catch was not significantly ($P<0.05$) higher than the night catch.

The total number of individuals of *Sarotherodon galilaeus* caught during the study period was 68. Out of the number, 33 or 48.53% were recorded in the daytime while 35 individuals representing 51.47% were recorded in the night. The daytime catch was not significantly higher ($P<0.05$) than the night catch.

Discussion

The diel variation of the composition of fish species in Agbura River has shown that the fish catch was much in the day (677 individuals representing 59.54%) compared with the night (460 individuals or 40.46%). This finding is similar to that recorded by (Meye and Ikomi, 2010). More so, out of 29 species recorded in the entire study period, 9 species were restricted to day catches only while 3 species were restricted to night times only. The remaining 17 species were caught during both day and night at 0600 and 0900h. This indicated that the 17 fish species were both nocturnal and diurnal using diel feeding pattern to escape predators.

Some of the fish species recorded in this study that were captured day and night were *Synodontis batensoda*, *Synodotis budgetti*, *Bagrus bayad macropterus*, *Chrysichthys nigrodigitatus*, *Gnathonemus abadii*, *Mormyrus rume*, *Oreochromis niloticus* and *Tilapia zilli*.

The family Bagridae appeared to be active during the night. This finding is similar to the works of Ikomi and Odum, 1998, who evaluated the diel variations in abundance of the characids in River Jamieson and observed that there was a significantly higher number of *B. longipinnis*, *R. smykalai* and *Alestes spilopterus* captured in the daytime than in the night thus indicating higher daytime activities of these species. Ikomi *et al.*, (2005) also reported that the cichlid *Thysia ansorgii* occurred throughout the year in the Ethiope River appearing more in vegetated areas. It occurred more in the daytime than at night.

Idodo-Umeh (2003) in his study of fishes in River Ase, reported that out of the 100 fish species caught in the river, 91 fish species were captured during the day while 70 fish species were captured during the night. More fish species were captured between 0600 and 0900h accounting for 1,229 out of the 4,226 individuals of all fish captured than at other time intervals. A total of 2,669 (63.20%) and 1,557 (36.80%) individuals were caught during the day and night respectively. He observed that more fish were caught at the time of the activities of the fish. *Citharinus citharus* and *Chrysichthys nigrodigitatus* which were the two most dominant species appear to be active during the day. He also reported that some species such as *Synodontis schall*, *Hydrocyanus forskalli*, *Chrysichthys auratus longifilis*, and *Hemisynodontis* were more active during the day while others were more active during the night. However, in this study, some other

species such as *Labeo senegalensis*, *Eutropius niloticus*, *Schilbe mystus* and *Pellucida afzelius* were not restricted to day or night catch.

Conclusion

In this study, the data obtained from the diel variations are important for the designing of Fish exploration and exploitation by fish farmers and future researchers in Agbura River. The findings will also help to characterize riverine fish assemblages in the context of fish behavioural studies.

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