Species Composition and Abundance of Cast Net Fishery of a Tropical Lotic Freshwater Ecosystem

[1]Okoh, F. A., [2]Eyo, J. E. and Ezenwaji, H. M. G.
[1]Department of Applied Biology, Ebonyi State University, Abakaliki, Ebonyi State, Nigeria
[2]Department of Zoology, University of Nigeria, Nsukka, Enugu State, Nigeria

Corresponding Author: Eyo, J. E. Department of Zoology, University of Nigeria, Nsukka, Enugu State. Email: divinelovejoe@yahoo.com Phone: +234854563188

Abstract

Cast net fishery of a tropical lotic freshwater ecosystem (Cross river at Afikpo, Nigeria) was investigated from December 2004 to November 2005. Thirty two (32) species of finfishes belonging to 23 genera and 16 families and one decapod crustacean – Macrobrachium volenhovenii were collected. Alestes baremoze was the dominant of the five species of the Characidae identified. The Cichlidae (4 species) had the highest weight (1887.77 kg) representing 75.39 % of the total catch and 1,175 (64.41%) abundance. The Bagriidae (3 species) had abundance value of 84(4.53%) and weight of 4.026 kg (3.46%). The Mochokidae (4 species) had abundance value of 44 (2.37 %) and 2.23 kg (1.91%) weight. The Notopteridae, Osteoglossidae, Schilbidae and Cyprinidae had one species each. Two species of the Carangidae; Decapterus rhonchus and Trachinotus teraia which are brackish water dwellers constituted 0.27 % and 0.03 % of the total abundance and weight respectively of the catch. The Cichlidae had the highest frequency followed by the Characidae. The Cichlidae had the highest Simpson's and Shannon Wienner diversity of 0.116 and 0.488 respectively. Simpson's and Shannon Wienner diversity of 0.861 and 0.988 were recorded for all the species. The monthly variation of the catch during the study showed double peak maxima in April/May and October/November. The mesh size of the cast nets used by the fishers varied from 3.25 cm to 3.85 cm with a mean size of 3.5 cm. Only 2(11%) of the 18 canoes used by the fishers were dugout types. The remaining 16 (89%) of the canoes were plank boats.

Keywords: Species composition, Abundance, Cast net fishery, Cross river, Freshwater ecosystem.

Introduction

The need for proteinous food continues to increase as the world's population grows. Fish provides a cheaper source of protein (Moses, 1983) especially in the tropical regions of the world wherein lie most of the developing nations. Fish is an important component in the diet of most Nigerians. It constitutes 40 – 50 % of the animal protein intake of the average Nigerian (Bayagbona, 1996).

Apart from its nutritional values, fish has other uses. *Gambusia affinis* and *Lebistis* species are used in the control of mosquito in ponds, while grass carp *Ctenopharyngodon idellus*) and some *Tilapia* species are used in the control of aquatic vegetation on account of their food habits.

Over the years, the demand for fish has been in the increase. As a result, the supply often lags behind the demand. Projected fish demand for Nigeria between 1991 and 2000 was put at 1.06 – 1.28 tons per annum, while domestic fish production was 0.30 and 0.60 tons per annum – a production value less than 30 % of the projected demand (Tobor, 1992). At the prevailing increase in population (of about 2,000,000 per annum), a further increase of 1 million tons of fish per annum is required to meet the demand of fish protein in Nigeria (Ugwumba and Ugwumba, 2003).

Therefore there is the need to increase production in order to bridge the gap. In attempt to bridge the gap in supply. Africa including Nigeria is very dependent upon import of fish (Holden *et al.*, 1974). Ugwumba and Ugwumba (2003) reported that in the year 1992 alone, Nigeria imported 378,414 tones of fish, i.e. 35,336 tons more than the annual production and approximately 190 million dollars was spent on the importation. It was argued that importation was not the answer, rather there was need to reduce importation and increase domestic production. Despite the prominence of fish protein in Nigeria diets, it is evident that the resources suitable for aquaculture in Nigerian are grossly unexploited (Bayagbona, 1996).

Nigeria has vast areas of perennials fresh and brackish water swamps covering 1,751,509 ha. These are unexploited but suitable areas for aquaculture (Ugwumba and Ugwumba, 2003). Nigeria has a land area of 923,850 km^2 bordering the Atlantic ocean in the gulf of guinea and maritime coast stretch of 46, 300 km^2 within the EEZ (Ita and Sado, 1985). Furthermore, there are many inland water bodies with an estimated of 125,470.82 km^2 (12.547, 082 ha) (Tobor, 1982). The contribution of inland waters such as lakes and rivers to the fishery sub-sector of the economy is quite significant (Moses, 1983). The bulk of domestic fish production (327, 931 tons) constituting 86.4% of the total production between 1991 and 2000 came from inshore coastal, brackish and inland waters (Ugwumba and Ugwumba, 2003). Cross River is a major component of the inland waters of South Eastern Nigeria and its role to the fishery of the area is quite significant.

In Northern Nigerian fisheries, the cast net catches more fish than any other single type of fish gear. They are more effective for catching the willy tilapias which avoid most gears (Reed *et al.*, 1967). Apart from the studies on the cast net fisheries of Northern Nigeria fisheries, (Reed *et al.*, 1967) similar studies has not been carried out in south

Eastern Nigeria including the Cross River freshwater ecosystem. This study investigated the monthly variations and abundance in fish species composition, and the length, mesh size, twine of netting and the number of ply of the cast nets used by the fishers. The number and type fishing vessels employed by the fishers in the study area was also investigated.

Materials and Methods

Fish samples were collected bimonthly on the 14th and 28th day of each month from four sampling locations – Ozizza, Ndibe, Enohia and Uwana – in the cross river basin at Afikpo, Nigeria (Fig. 1).

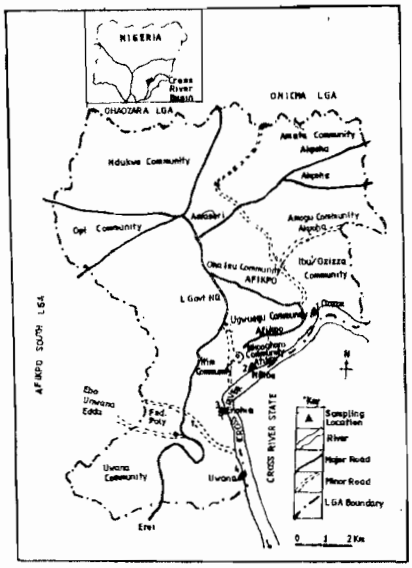

Figure 1: Map of Afikpo North Local Government Area showing the sampling locations along Cross river basin

The collections were made from December 2004 to November 2005. The catches were made using casts nets. Active fishing lasted for 3 hours per sampling day. The samples were sorted and identified up to species level using the guides of, Daget *et al.*, (1984,1986 a, b) Teugels *et al.* (1992) and Olaosebikan and Raji (1998). The body weight of each fish was also measured to the nearest 0.01g using the mettler weighing balance (Model PC 2000).

The measurements of the cast nets were made using measuring tape to the nearest 0.1 cm. Measurements made were the length and mesh size of the cast nets. The length was measured by measuring lengthwise from the base of the haul line to the lead edge. Mesh size was determined by measuring the diagonal length of the mesh. The netting twine was also carefully observed to determine whether it was monofilament or multifilament. The number of ply was also counted and recorded.

The length of the canoes used by each fishing unit was measured from one end to the other using a tape. The type of canoe (dug-out or planked) was also observed and recorded.

The data on fish composition were analyzed quantitatively to determine the total abundance, percentage abundance and percentage total weight of each fish family and species identified during the study period. Species diversity was calculated using Simpson's and Shannon – Wiener indices as described by Odum and Barret (2005). (a) Simpson's diversity (D) was calculated using the formula: $D = -\sum (P^2 i)$, Where D = Simpson's diversity and Pi is the probability of picking species I. (b) Shannon-Wiener diversity (H) was calculated using the equation: $H = \sum Pi \log Pi$, where H is Shannon-Wiener diversity Index and Pi = proportion of species in the whole. All statistical analysis was done using the statistic programme for Social Sciences (SPSS)

Results

Species composition and Abundance: Thirty two (32) species of finfish's belonging to 23 genera and 16 families and one decapod crustacean *Macrobrachium volenhovenii* were encountered (Table 1). *Alestes baremoze* was the most dominant of all the 5 species of the Characidae caught. The other characids harvested include, *Hydrocynus vittatus*, *Alestes macrophthalmus*, *Brycinus nurse* and *Hepsetus odoe*. Members of the family Cichlidae (4 species) had the highest weight (87.77 g) representing 75.3 % of the total catch and 1,175 (63.41 %) abundance. The family Bagridae, represented by 3 species, had abundance value of 84 (4.53 %) and weight of 4.026 kg (3.46%). The Mochokidae (4 species) had abundance value of 44 (2.37 %) and weight of 2.23 kg (1.91 %). The Notopteridae, Osteoglossidae, the Schilbeidae and Cyprinidae had only one species each.

The brackish water fish, Carangidae was represented in the catch by 2 species *Decapterus rhonchus* and *Trachinotus teraia*, contributing 0.27 % and 0.03 % to the total abundance and percentage weight of the cast net fishery of the Cross river respectively.

The Cichlidae had the highest frequency of occurrence followed by the Characidae (Fig. 2). The Cichlidae had the highest Simpson's and Shannon-Wiener diversity indices of 0.12 and 0.49 respectively. A Simpson's and Shannon Wienner diversity values of 0.86 and 0.99 were recorded for the fish species in Cross river (Table 2).

The highest fish number of fish was harvested in November followed by April (Fig. 3), thus resulting in the highest fish biomass harvested in November followed by April (Fig. 4).

The gear and the craft: The length of the cast nets were varied from 3.31 to 4.61m, with a mean length of 3.367 ± 0.55 m. The mesh size varied from 3.20 cm to 3.85 cm, with a mean size of 3.75 cm. All twine of the netting materials were monofilament while the number of ply were different (Table 3). The cost of the cast nets were size dependent and ranged between ₦ 4,500: 00 to ₦ 5,500:00 with an average price of ₦ 5,150: 00.

Table 1: Fish and shellfish species composition of cast net fishery of upper Cross river basin, Nigeria

FISH SPECIES	Weight g	% Weight	No	% No
CHARACIDAE				
Hydrocynus vittatus Castelnau 1861	115.24	0.13	1.00	0.06
Alestes baremoze de Joannis 1835	5448.22	6.00	187.00	10.70
Alestes macrophthalmus Gunther 1867	4270.76	4.71	160.00	9.16
Brycinus nurse de Joannis 1835	4470.87	4.93	93.00	5.32
Hepsetus Odoe Bloch 1794	148.08	0.16	15.00	0.86
BAGRIDAE				
Chrysichthys nigrodigitatus Lacepede 1803	992.88	1.09	13.00	0.74
Chrysichthys auratus Geoffrey Saint Hillaire 1808	2174.71	2.40	56.00	3.21
Chrysichthys aluuensis Risch 1985	858.72	0.95	15.00	0.86
CLARIIDAE				
Clarias gariepinus Burchell 1822	5754.46	6.34	57.00	3.26
MOCHOKIDAE				
Synodontis clarias Linne 1758	774.70	0.85	11.00	0.63
Synodontis robbianus Smith 1875	563.58	0.62	12.00	0.69
Synodontis obesus Boulenger 1898	132.95	0.15	6.00	0.34
Synodontis courteti Pellegrin 1906	759.89	0.84	15.00	0.86
NOTOPTERIDAE				
Papyrocranus afer Gunther 1868	65.12	0.07	1.00	0.06
CICHLIDAE				
Tilapia guineensis Bleeker 1862	29735.54	32.76	477.00	27.30
Hemichromis fasciatus Peters 1852	21913.47	24.14	303.00	17.34
Oreochromis niloticus Linne 1758	10493.85	11.56	194.00	11.10
MORMYRIDAE				
Marcusenius senegalensis Steindachner 1870	80.57	0.09	3.00	0.17
Gnathonemus petersii Gunther 1862	160.12	0.18	1.00	0.06
Mormyrus hasselguistii Valenciennes 1846	25.45	0.03	1.00	0.06
Mormyrus rume Valenciennes 1846	220.16	0.24	1.00	0.06
Petrocephalus ansorgii Boulenger 1902	19.13	0.02	3.00	0.17
DISTICHODONTIDAE				
Phago loricatus Gunther 1865	10.14	0.01	1.00	0.06
Paradistichodus dimidiatus Pellegrin 1904	15.13	0.02	1.00	0.06
SCHILBEIDAE				
Schilbe uranoscopus Ruppell 1832	216.87	0.24	4.00	0.23
OSTEOGLOSSIDAE				
Heterotis niloticus Curvier 1829	910.43	1.00	5.00	0.29
CYPRINIDAE				
Labeo parvus Boulenger 1902	68.69	0.08	2.00	0.11
ELEOTRIDAE				
Eleotris daganensis Steindachner 1870	116.50	0.13	1.00	0.06
CRUSTACEANS				
Macrobrachium vollenhovenii Herklots 1857	253.35	0.28	8.00	0.46
CARANGIDAE				
Decapterus rhonchus Geoffrey Saint Hillaire 1817				
Trachinotus teraia Curvier 1832	16.44		2.00	
TOTAL	**90785.13**		**1647**	**1652**

The largest canoe used by the fishers was 5.65 m and the smallest was 3.40 m. Only 2 (11%) were the dug out boats while the remaining sixteen canoes were planked brats (Table 4).

Discussion

Thirty two (32) species of finfish and one crustacean species were recorded in this study. Compared with the report of Teugels *et al.* (1992), the present result shows that only 19.27 % of the 166 species recorded by the workers from the fisheries of the Cross river basin was recorded. The disparity in identified species may be due to multi-gear system fish sampling employed by Teugels *et al.* (1992) unlike the use of cast net in the exploitation of fish species during this study. The cast net was used in shallow waters and needed high skill to manipulate. This implies that the cast net as a single gear is limited in its use in assessing the fisheries of a water body. Although Reed *et al.* (1967) and Nedelee and Prado (1990) stated in the contrary.

The low finfish species diversity reported in this study might be due to the limited sampling site (Afikpo region) of the Cross river. Moreover, the cast net was only effective in open water where there were no obstacles. King (1996) reported that most of the fishes of Cross River have restricted location between the upper and lower regions of the river. Only detailed and seasonal study employing various gears will reveal the piscifauna of the river.

The dominance of the fish fauna of the river by the cichlids agrees with the findings of Nedelee and Prado (1990) for river ecosystems and Idowu and Eyo (2005) for lake Alau that the cast net was more effective in catching the willy Tilapia that avoid most gears.

The Carangidae, *Decapterus rhonclus* and *Trachinotus teraisa* that are brackish water species were also encountered in this study. King (1996) noted that there were many marine intrusive species in the Cross river of *D. rhonclus* and *T. teraisa* are prone to cast netting.

The monthly variation of the catch during the study revealed double peak maxima in April/May and October/November. These are dry season period when the water level is low. Nedelee and Prado (1990) observed that cast nets were most effective during periods of low water

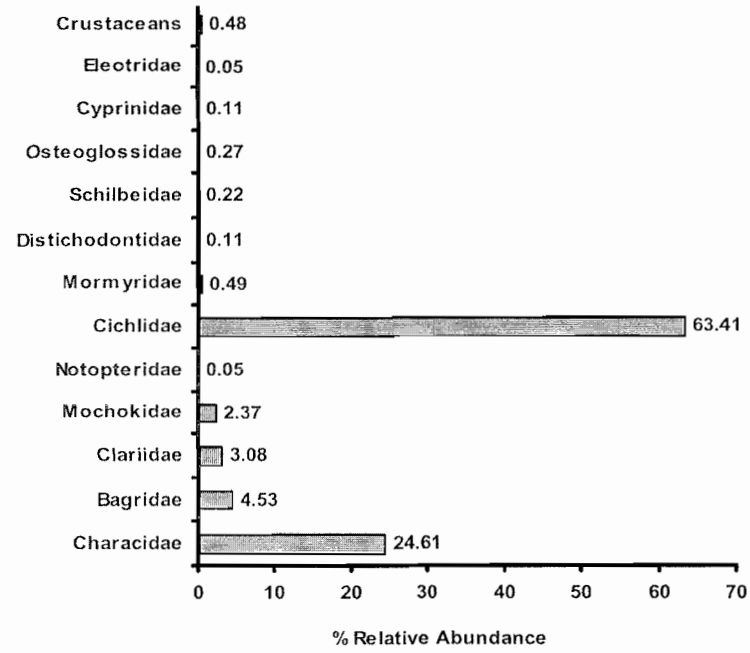

Fig. 2: Relative abundance of finfish and shellfish families in upper Cross river from cast net samples

Table 2: A summary of the Simpson's and Shannon-Weiner diversity of the different finfish and shellfish families identified in upper Cross river basin from cast net samples

Family of fish	No of fish	Mean weight of fishes	Simpson's Diversity	Shannon Wiener Diversity
Characidae	456	14453.17	0.020	0.276
Bagridae	84	4026..31	0.001	0.078
Clariidae	57	5754.46	0.001	0.047
Mochokidae	44	2231.117	$1.53x10^{-4}$	0.052
Notopteridae	1	65.12	$2.91x10^{-7}$	0.002
Cichlidae	1175	87773.99	0.116	0.488
Mormyridae	9	505.43	$6.12x10^{-6}$	0.014
Distichodontidae	2	25..27	$5.82x10^{-7}$	0.004
Schilbeidae	4	216.87	$4.66x10^{-6}$	0.006
Osteoglossidae	5	116.5	$2.91x10^{-7}$	0.002
Cyprinidae	2	910.43	$7.28x10^{-6}$	0.007
Eleotridae	1	68.69	$1.16x10^{-6}$	0.003
Crustaceans	8	31..97	$3.73x10^{-5}$	0.020
Total	1853	**116433.21**	**0.861874**	**0.988**

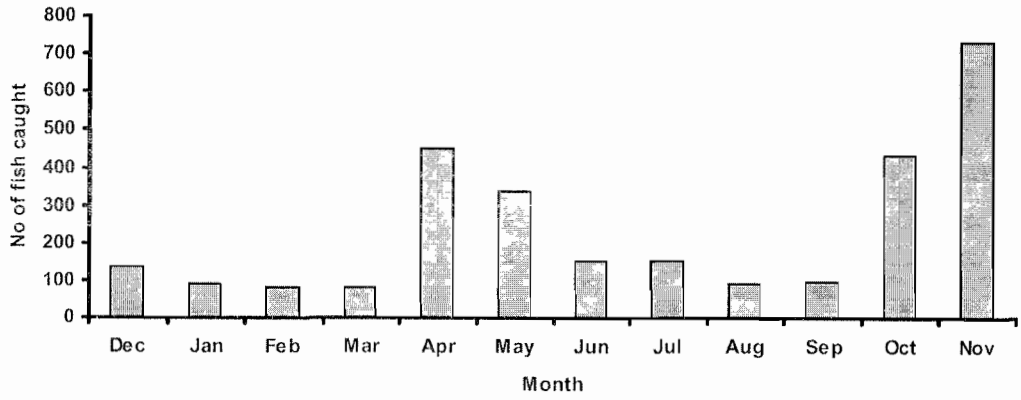

Fig 3: Monthly variations in cast net fish catch in upper Cross river basin during the study period

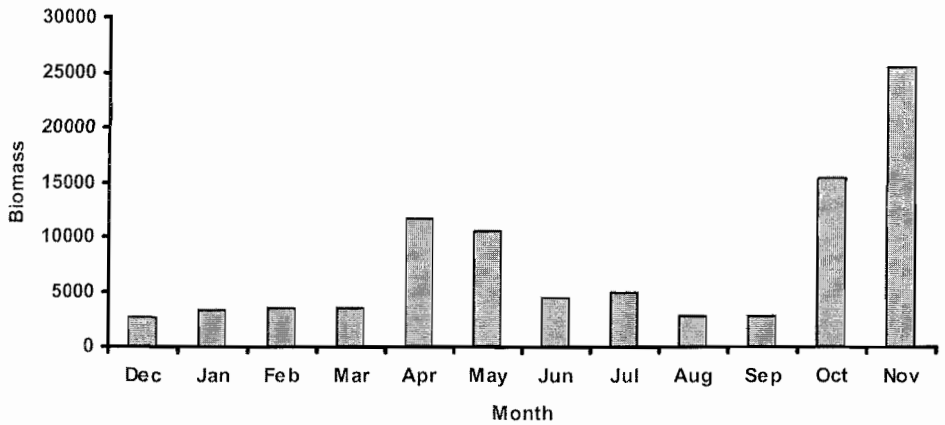

Fig 4: Monthly variations in biomass of fish caught in upperCross river basin using cast net

Table 3: The different lengths, mesh sizes, types and cost of net used by fishers in upper Cross river freshwater ecosystem

S/N	Length (m)	Mesh size (cm)	Mono-filament	Multi-filament	No. of ply	Cost (₦)
1	3.31	3.50	1	0	13	4,500.00
2	3.43	3.75	1	0	13	5,100.00
3	2.81	3.20	1	0	9	4,500.00
4	3.51	3.50	1	0	13	5,000.00
5	3.66	3.50	1	0	13	4800.00
6	3.80	3.70	1	0	13	4,500.00
7	3.65	3.22	1	0	13	4,500.00
8	2.75	3.25	1	0	13	4,500.00
9	4.51	3.85	1	0	13	5,500.00
10	4.51	3.80	1	0	15	5,500.00
11	4.61	3.80	1	0	15	5,500.00
12	3.21	3.50	1	0	13	4,500.00
13	3.35	3.50	1	0	13	5,100.00
14	3.35	3.50	1	0	13	4,500.00
15	3.70	3.50	1	0	15	4,500.00
16	4.45	3.75	1	0	13	5,200.00
17	3.85	3.70	1	0	15	4,500.00
18	3.65	3.50	1	0	13	4,500.00
Mean	**3.67**	**3.75**	**1**	**0**	**13.01**	**5,150.00**

Key: 1 = Yes, 0 = No, ₦ = Naira (Nigerian official currency)

Table 4: Length and Type of canoe employed in cast net of Cross river freshwater ecosystem

No	Length canoe (m)	Type of canoe planked	Dug-out
1	3.45	1	0
2	3.40	0	1
3	4.42	1	0
4	4.80	1	0
5	5.21	1	0
6	4.48	1	0
7	4.45	1	0
8	4.48	1	0
9	3.45	0	1
10	3.48	1	0
11	5.25	1	0
12	4.25	1	0
13	3.45	1	0
14	4.92	1	0
15	5.65	1	0
16	5.55	1	0
17	4.58	1	0
18	4.50	1	0
Total		**16**	**2**
Mean	**4.43**	**-**	**-**

Key: 1 = Yes, 0 = No

The mesh size of the cast nets ranged from 3.25 to 3.8 cm, which compares with the findings of Eyo and Akpati (1995) who reported that cast nets of average mesh size 3.5 cm were used in Anambra River fisheries. The size of the cast nets varied and this agrees with Reed *et al.* (1967) who noted that the size of cast of nets varied amongst the fishing units according to individual preferences and the fishers ability to manipulate the net.

Only 2 (11 %) of the 18 canoes used by the fishers were the dug-out types. This may be due to the fact that construction of dug-out canoe is labourious, time consuming, requires patience and special skills. This result is in consistent with the report of Ezenwaji (1997) which stated that most of the gears and craft made from indigenous materials were being replaced with more modern ones.

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