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Gillnet Selectivity and Abundance of African Butter Catfish *Schilbe mystus* (Linnaeus, 1758) in Lower River Ogun, Nigeria

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ABSTRACT
The increasing demand for fish as dietary protein source has led to overfishing, use of banned fishing devices and other activities that are inimical to fisheries and threats to aquatic systems reducing their productivity in general. This study was carried out to identify and estimate the impact of gill net selectivity on *Schilbe mystus* (Linnaeus, 1758) in lower River Ogun, Akomoje. 102 samples of different sizes were randomly selected from catches made with the use of gill nets of different mesh sizes (3-8cm) between June and November 2017. Length and weight parameters were estimated by standard method. Abundance was least in the months of September and October which was their spawning season. The highest represented length class was from 16-16.9 cm and 14-14.9 cm, accounting for 16.7 %and 14.7% of the average monthly catches respectively. There was gill net selectivity with the smallest mesh size gill net being the most efficient, accounting for 95% of the number of the total catch. The small and medium gill nets were largely inefficient compared to the 'very small' gill net.

INTRODUCTION

The freshwater African butter catfish, *Schilbe mystus*, (Linnaeus, 1758) family Schilbeidae is a dominant fish species in the inland waters of Nigeria. This species is carnivorous in nature, it is a good quality food fish with white and tasty flesh serving as a delicacy for many low and middle income earners especially in South West, Nigeria (Ayoade *et al*., 2004). In addition, it is important both in ecological and economic terms, playing salient role in determining the dynamics and structure of aquatic ecosystem (Kareem *et al*., 2015). This species, though not in the IUCN list of threatened species, however, overexploitation of the world's fisheries is the subject of much recent concern (Hilborn *et al*., 2003). Studies have shown that uncontrolled exploitation of fish stocks is threatening biodiversity in fresh waters globally while also putting jobs and food supplies in developing nations at risk. There are evidences that humans are fishing their way through different size fish starting with the largest and progressively down the size scale until there's nothing left to catch (National Geographic News, 2005).

Gill net is the most popular fishing gear among fisher folks in coastal and brackish waters (Olawusi-Peters *et al*., 2015). Studies had shown that gill net constitute over 75% of the total fishing gear used in the inland coastal water in Nigeria (Ago *et al*., 2014).

Evidences exist that in the Lagos lagoon, gill net is the dominant fishing gear used in the water body (Kingdom and Allison, 2007). Emmanuel *et al*. (2008) observed size selection of gill nets as being crucial to fisheries management to maximize sustainable yields. Body form and presence of spines may cause discrimination in fishing among fish species, however, Allison and Okadi (2013) 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. Other recent studies on gill net in Nigeria water bodies are those Emmanuel *et al*. (2008) and Emmanuel (2009). There is a dearth of information on the giil net selectivity of *S. mystus*. Very little attention had hitherto been paid to the fish and fisheries of River Ogun, Nigeria.

The study on the abundance, and gill net selectivity of this species was therefore aimed at providing ecological, and fishery information to ensure rational exploitation of *S. mystus* to sustain its fishery in the Lower River Ogun.

MATERIALS AND METHODS

Study Area

The study was carried out at lower River Ogun, Akomoje in Abeokuta, Ogun State, Nigeria (Figure 1). It has a total area of 22.4 km 2 , and a fairly large flow of an estimated 393 m 3 /s during the wet season (Oketola *et al*., 2006). The River Ogun lies between 3°28′E and 8°41′N from its source in Oyo state to 3°25′E, and 6°35′N in Lagos State where it enters the Lagos lagoon through an estuary (Adeosun *et al*., 2017). The major tributaries of the river are Ofiki River, and Opeki River.

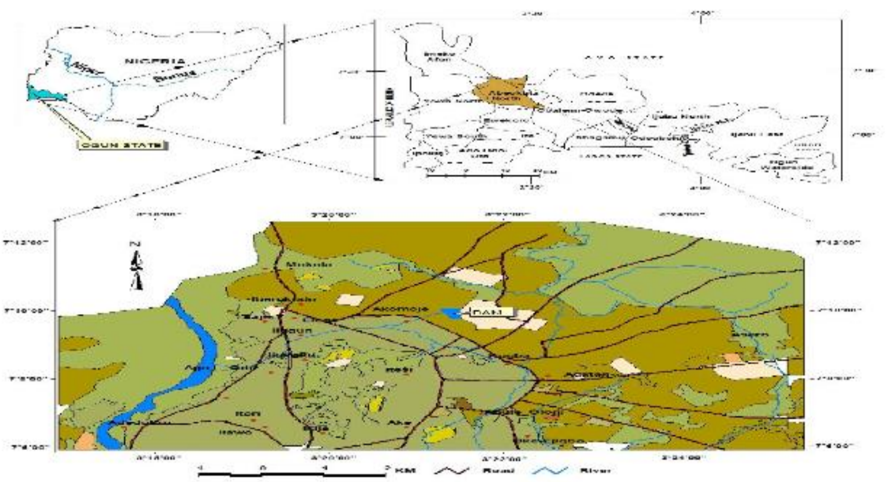

Fig. 1. A map of River Ogun.

Source: Google maps (2012)

Sampling procedure

Sampling was carried out for six calendar months biweekly (June – November 2017) using four different mesh sizes of mono-filament with stretched mesh sizes of 3, 4, 6, and 8 cm, twine size of 210d/2 (46 tex) and hung at 50% (E = 0.5). Gillnets were classified as smallest, small, medium, and large gill net respectively base on mesh sizes with each measuring 35 m in length, 3 m in depth and a surface area of 105 m 2. Sampling was done at three locations: the concave, central and convex sections of the study area. The four mesh sizes were joined using the head rope, and foot rope making it into one long gill net which was operated from one (1) fishing canoe by two (2) fishermen. At each location, sampling covered surface, mid-, and bottom waters, carried out by a simple manipulation of the float line, and the weighted bottom line so as to keep the net at the desired depth. This was done to determine the distribution, and abundance of the species in the study area. Gill nets was usually set at night and retrieved in the morning to determine the effect of photoperiod on abundance, and biomass of *S. mystus* as well as during low, and high tides to determine tidal variations in abundance, and biomass of the fish. The catches were counted, and weighed separately according to the respective mesh sizes of the gill nets used. The monthly mean catches of *S. mystus* were pooled to determine the seasonal variation.

Gill net selectivity was determined from the differences in the totality of species, numbers, and biomass caught by the various mesh sizes of gill nets (Adeosun *et al*., 2011; Ago *et al*., 2014).

Experimental protocols carried out on the animals were in accordance with the internationally accepted principles for the laboratory animal usage, and were approved by Ethics Committee on the Laboratory Animal Use of the College of Veterinary Medicine of the Federal University of Agriculture, Abeokuta, Nigeria.

Protocol for fish identification

Experimental fish were identified by the fish farmers based on its physical appearance. Specimens were further subjected to further identification using available keys of Idodo-Umeh (2003).

Gill net setup

A canoe was used with two fishermen, one maneuvering the canoe with a paddle, and the other was setting the net. The net was orderly packed in the canoe with the floats line separated from the sinkers line, and gradually released into the lagoon from one end to the other. As the setting progressed, the net was released astern, and the fisherman paddling the canoe maneuvered ahead usually setting parallel to the direction of current flow for ease of operation. The net is then set, and left overnight to capture fishes, and the gill nets are then retrieved in the morning.

Gill net selectivity

Catches of the four different mesh size nets were landed separately and enumerated to determine species abundance and weighed using a digital top loading balance (Mettler Toledo, Model 2000) for bigger sizes and for smaller sizes, (Mettler Toledo 30216566 Model ME4002TE Precision Balance), and then preserved in 10% formalin solution in plastic containers. Fish specimens were identified using monographs, descriptions, checklist, and keys (Olaosebikan and Aminu 1998). Gill net selectivity was determined from the differences in the totality of species, numbers, and biomass caught by the various gill nets.

Data analysis

Analysis of catches by months, and gill net mesh sizes was carried out using Analysis of variance (ANOVA) for separation of the means with Statistical packages for Social Sciences (SPSS V.20).

RESULTS

Mean monthly catch and length class of *S. mystus* in Lower River Ogun

The mean monthly catch of S mystus is shown in Table 1. The species was caught throughout the duration of the study. Abundance was least in the month of September, and October, and highest in the month of June.

Table 1: Monthly catch and length class of *S. mystus* catch in Lower River Ogun, Akomoje.

Length (cm)	JUN	JUL	AUG	SEPT	OCT	NOV	Total	Mean Wt.
11– 1.9	0	0	0	1	0	0	1	23
12 – 12. 9	0	0	0	0	1	3	4	22
13 – 13.9	0	1	1	1	2	1	6	25.2
14 – 14.9	1	1	2	3	4	4	15	25.3
15 – 15.9	1	1	2	1	2	2	9	27.8
16 – 16.9	4	4	4	2	2	1	17	35.6
17 – 17.9	4	3	3	0	0	1	11	40.1
18 – 18.9	3	3	3	0	0	1	10	38.6
19 – 19.9	4	3	2	2	0	3	14	49.6
20 – 20.9	2	1	1	0	0	1	5	57.2
21 – 21.9	1	1	1	1	0	1	5	59
22 – 22.9	0	0	0	0	0	1	1	66
23 – 23.9	0	0	0	0	0	0	0	0
24 – 24.9	0	0	0	0	0	0	0	0
25 – 25.9	0	1	1	0	0	0	2	64
26 – 26.9	0	0	0	0	0	0	0	0
27 – 27.9	0	0	0	0	0	1	1	68
28 – 28.9	0	1	0	0	0	0	1	65
Total No.	20	20	20	11	11	20	102	
Mean Wt(g)	41.4±12.6	42.35±14.3	38.45±13.3	32.7±15.2	28.3±2.6	39.55±16.1		

Frequency and percentage of length class

Table 2 represents the effect of frequency, and percentage of length class on total number of fish caught; the highest (16.7%) was recorded in length class 16.0-16.9cm during the sampling period.

Table 2: Frequency and percentage of length class in total number of fish caught

Length (cm)	Frequency	Percentage (%)
11– 1.9	1	1.0
12 – 12. 9	4	3.9
13 – 13.9	6	5.9
14 – 14.9	15	14.7
15 – 15.9	9	8.8
16 – 16.9	17	16.7
17 – 17.9	11	10.8
18 – 18.9	10	9.8
19 – 19.9	14	13.7
20 – 20.9	5	4.9
21 – 21.9	5	4.9
22 – 22.9	1	1.0
23 – 23.9	0	0
24 – 24.9	0	0
25 – 25.9	2	2.0
26 – 26.9	0	0
27 – 27.9	1	1.0
28 – 28.9	1	1.0
TOTAL	102	100

Catch composition of fish species by weight in the study area

A total of 20 species belonging to 10 families were the most abundant fish species caught with *S. mystus* (27.58%) representing the highest percentage of the catch during the study period. Followed closely was Chrysicthys nigrodigitatus (24%), and Chrysichthys auratus (18%). Others were Auchenoglanis occidentalis, Distichodus rostratus, Hydrocynus brevis, Sarotherodon melantheron, and Mormyrus macrophthalmus, and contributed 2% of the total catch in Figure 2.

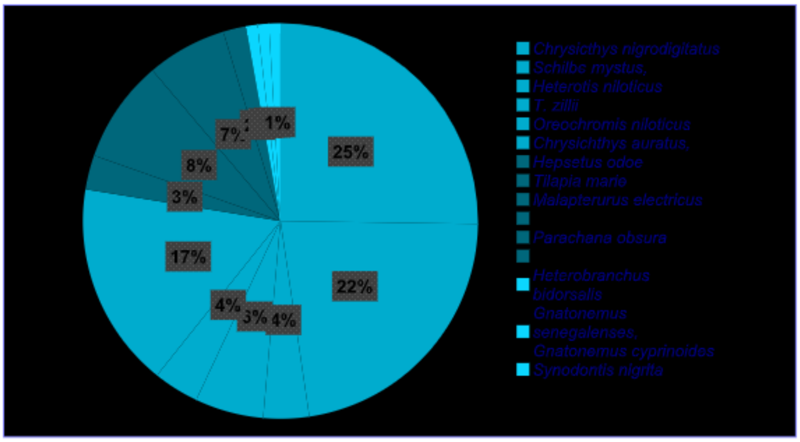

Fig. 2: Catch composition of fish spp. in Akomoje Lower River Ogun.

Gill net selectivity in River Ogun

The catches of *S. mystus* from the four different gill nets are presented in Figure 3. The gill net selectivity showed that the smallest mesh size in the gill net was the most efficient; accounting for 95% of the total catch, the medium mesh size net was largely inefficient relative to the optimal fish size. Of the total 102 fish catch, only six (6) was caught with the medium gill net, which was significantly different to the catch in smallest gill net that is most effective at catching fish of below 22cm total length as depicted in Figure 4.

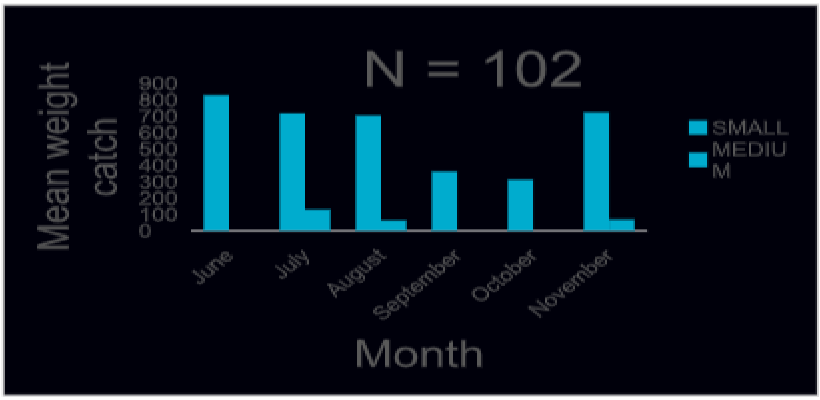

Fig. 3: Effect of mesh size and month of catch of *S. mystus* in Lower River Ogun.

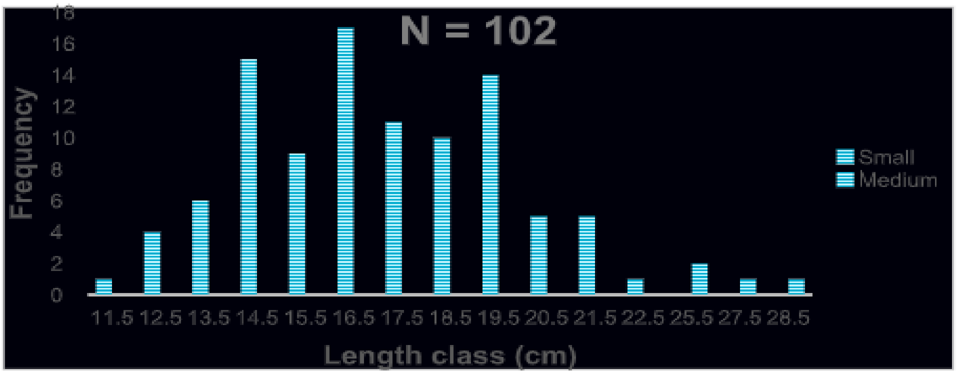

Fig. 4: Effect of mesh size on length class frequency of *S. mystus* in Lower River Ogun.

DISCUSSION

The summary of the result showed that food items consumed by *T. mariae* are predominantly aquatic microscopic plants and confirms the herbivorous food habit documented for the species Ikomi and Jessa (2003). Generally, the importance of the plant materials; *Bacillariophyta*, *Cyanophyceae* and *Chlorophyta* in the diet of *T. mariae* from this water body was clearly demonstrated from both the frequency of occurrence and numerical methods of gut content analyses throughout the study months. This observation agreed with previous studies on other Cichlid species such as Uneke (2017) on the food habits of *Tilapia zilli*, Ekpo *et al*. (2014) on *Tilapia guineensis* and *Sarotherodon melanotheron*. This is because the gill rakers morphology of Tilapia, Oreochromis and Saroherodon favours consumption of phytoplankton and it's also a pointer to the abundance of its preferred food items in this water body. High percentage of substrate detrital materials (algae and plants) found in the stomach of the species confirms that the species are substrate dwellers and spawners and thus are deposit feeders. This could be attributable to its dentition (Bradford *et al*., 2011). Similar result was reported by some other authors (Osho *et al*., 2006; Atindana *et al*., 2016). Welcomme (1985) reported that detritus in the food of fish is a major contributor of energy for fish.

The study by Bradford *et al*. (2011) on the food consumed mainly by the species and other Cichlids revealed the low presence of animal sources, comprising fish remains, free-swimming invertebrates, Protozoa, benthic invertebrates, fish eggs, allochthonous invertebrates, Rotifera and invertebrate larvae. Atindana *et al*. (2016) reported the presence of benthic invertebrates and fish scales/parts in other Cichlids species from the central region of Ghana. Also, Ikomi and Jessa (2003) and Fagade 1971 documented that *T. mariae* are benthic herbivores as 85% of their food comprise diatoms, algae, aquatic macrophytes and detritus with 5% comprising benthic invertebrates and terrestrial insects. The findings of this study agreed with these studies as crustaceans were observed in low proportions. This may be due to high populations of the planktons in this water body and the preference for phytoplankton by this species.

Low percentage of empty stomach reported during the study period is an indication that the species is more or less a continuous feeder and agreed with the review of the biology of the species by Bradford *et al*. (2011). Monthly variation observed in the food habits of the species as the diet breadth was expanded during the wet season, and a number of food items like crustaceans were excluded from the diet in the dry months and in the beginning of the wet months. This was also the case in the study by Ikomi and Jessa (2003) who reported high diversity of food item during the wet season in this species from the River Ethiope, Niger. The reason for the expanded diet breadth during the wet season is not clear as the wet season would be expected to be the period of greatest resource abundance phytoplankton. It could however be due to the flowing nature of the water (lotic) with plankton well dispersed and resident life low. The larger occurrence of these food items may be as a result of large phytoplankton distribution in the water body, and the reduced number of food consumed may be a result of the gut size or reproductive physiology of the fish. As observed by Ikomi and Jessa (2003), *T. mariae* is a substratum spawner and spawns throughout the year; this therefore may limit the number of food consumed.

The length exponent 'b' of the length-weight relationship for the species from this water body indicated a negative allometric growth pattern. Negative allometry recorded for this species in this study indicated that the species do not grow symmetrically, meaning as the species grows in length, it grows thinner and thus reduce in weight which could be due among other factors to gonad maturity, diet (Bradford *et al.*, 2011), sex, seasons, growth increment, sample size, temperature and salinity of the environment, fishing, individual metabolism, habitat suitability, age and maturity (Atama *et al*. 2013; Uneke *et al*., 2017). Other studies that reported similar findings are that of Atama *et al*. (2013), who reported negative allometry for both male and females in both wet and dry months, and Dan-Kishiya (2013), also reported similar allometry for both males and females of the species. Ikomi and Jessa (2003) reported an isometric growth for this species from the Ethiope River. This difference could be due to the above listed factors.

Condition factor was higher for females than the males and in the dry months and onset of the wet months (April) than the months of May and June. This agreed with the findings of Ikomi and Jessa (2003) in their study on aspects of the biology of *T. mariae* in Ethiope River and could be because the female samples were either gravid or on high vitellogenic phase. Generally, 'k' values recorded for the species in this water body were higher than '1' which indicated availability of good quality food and environmental conditions during the study. Bagenal and Tesch (1978) posited that condition factor "k" ≥ 0.5 indicates proper well being of the fish. Sex ratio recorded revealed a higher number of females than males. Anene and Okorie (2008) in their study of the sex ratio of *T. mariae* from Umuoseriche Lake reported the preponderance of female sex. Similar finding was reported by King (1994) for the same species of fish from a tropical rain forest stream.

CONCLUSION

The study concluded that *S. mystus* is already diminished in this water body as majority of the fish caught were of small sizes compared to other research of other water bodies. Also, the knowledge of gill net selectivity as observed in this study will be useful in decision making to ensure that appropriate mesh size for a sustainable fishery is employed in Lower River Ogun, Akomoje, Nigeria to prevent over-exploitation of economically important fish species.

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