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SHORT COMMUNICATION **KISA ARAŞTIRMA**

Diversity and abundance of the family Mugilidae in the New Calabar River, Nigeria

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Abstract: The study was conducted to determine the diversity and abundance of mullets (Mugilidae) in the New Calabar River, Nigeria. Fish samples were collected monthly between February to July 2018 at three landing stations: Choba: Station 1, Ogbogoro: Station 2 and Iwofe: Station 3. A total of 578 individuals belonging to three species (Sicklefin mullet (*Neochelon falcipinnis* Valenciennes, 1836), Largescaled mullet (*Parachelon grandisquamis* Valenciennes, 1836) and Flathead grey mullet (*Mugil cephalus* Linnaeus, 1758) of the family Mugilidae were sampled. *N.falcipinus* recorded the highest abundance (47.40%) followed by *M.cephalus* (36.85%) while *P.grandisquamis* recorded the least abundant (15.74%). The Simpson's index of diversity had the highest value of 0.63 in Choba station and the least value of 0.59 in Iwofe station, while the Simpson's reciprocal index highest value of 1.71 in Iwofe station and least value of 1.60 in Choba station. The Shannon- Weiner index and Pielou's eveness index value also recorded highest values of 1.03 and 0.94 in Choba station with the least values of 0.96 and 0.87 in Iwofe station respectively. The diversity indices showed that the family Mugilidae is fairly distributed in the study area and it is therefore recommended that further research should be carried out to provide a complete examination of the biology and ecology of the mullets within the New Calabar River.

Keywords: Diversity indices, mullets, abundance, New Calabar River,

INTRODUCTION

The family Mugilidae containing ray-finned fishes commonly called mullets or grey mullets, are one of the most ubiquitous teleost families in coastal waters of the world, occurring in most temperate, sub-tropical and tropical waters in both hemispheres (Crosetti and Blaber, 2016). Mugilidae belongs to the order Mugiliformes, containing 18 genera and 81 species (Nelson, 2006; Froese and Pauly, 2011).

Mullets have been said to be semi-catadromous, with the recruitment of its juveniles to lagoons and estuaries, following a period of offshore spawning (Ditty and Shaw, 1996; Blaber, 2000). The extraordinary adaptability of the family Mugilidae, has resulted in species that are found mainly in the clear and pristine waters of coral reefs to those that prefer highly turbid estuarine and fresh waters (Crosetti and Blaber, 2016). The family is represented in Nigerian freshwater by genus consisting of three species namely *Mugil cephalus, Mugil falcipinnis* and *Mugil hyselopterus* (Adesulu and Sydenham, 2007).

They are mostly benthic feeders which grow and thrive well on diatoms, aquatic macrophytes, benthic rotifer, larvae, fish eggs, cyclops, copepods, organic detritus and small algal cells, which are scooped up by the fish when swimming at an angle to the bottom running their mouth through the sediments, hence they do not compete for food making them very successful and well distributed in all tropical and temperate waters of the world (Rhema et al., 2002). Fishery resources (mullets included) are declining due to overexploitation and inadequate management of inland and coastal waters as well as environmental degradation (Lawson and Olusanya, 2010; Jamu and Ayinla 2003). Inland fisheries give about 82% of domestic fish production (FDF, 1994), thereby exposing mullets to exploitation risks especially because of its high quality meat and palatable taste.

The present research work therefore, aims at investigating composition, distribution and diversity of the Mugilidae in the New Calabar River which will be helpful in the management and development of fishery in the river.

MATERIALS AND METHODS

Study area

The study was carried out in the New Calabar River of Rivers State, Nigeria which is a partially mixed estuarine River (Figure 1). The climate is tropical, with high rainfall and annual precipitation of 2372 mm (range 2000 – 3000 mm; (Abowei 2000).

The New Calabar River is a black water type (RPI, 1985; Ubong and Gobo, 2001), which takes its rise from Elele-Alimini where it is acidic, fresh and non-tidal (Erondu and Chindah, 1991). It is joined by a smaller tributary river at Aluu, which takes its rise at Isiokpo. It further empties into some creeks and lagoons bordering the Atlantic Ocean. According to Dienye (2015), the New Calabar River is regarded as important water resources in the Niger delta region of southern Nigeria, because a lot of communities present around these areas directly depend on the river for their agricultural, recreational and sometimes domestic water supplies.

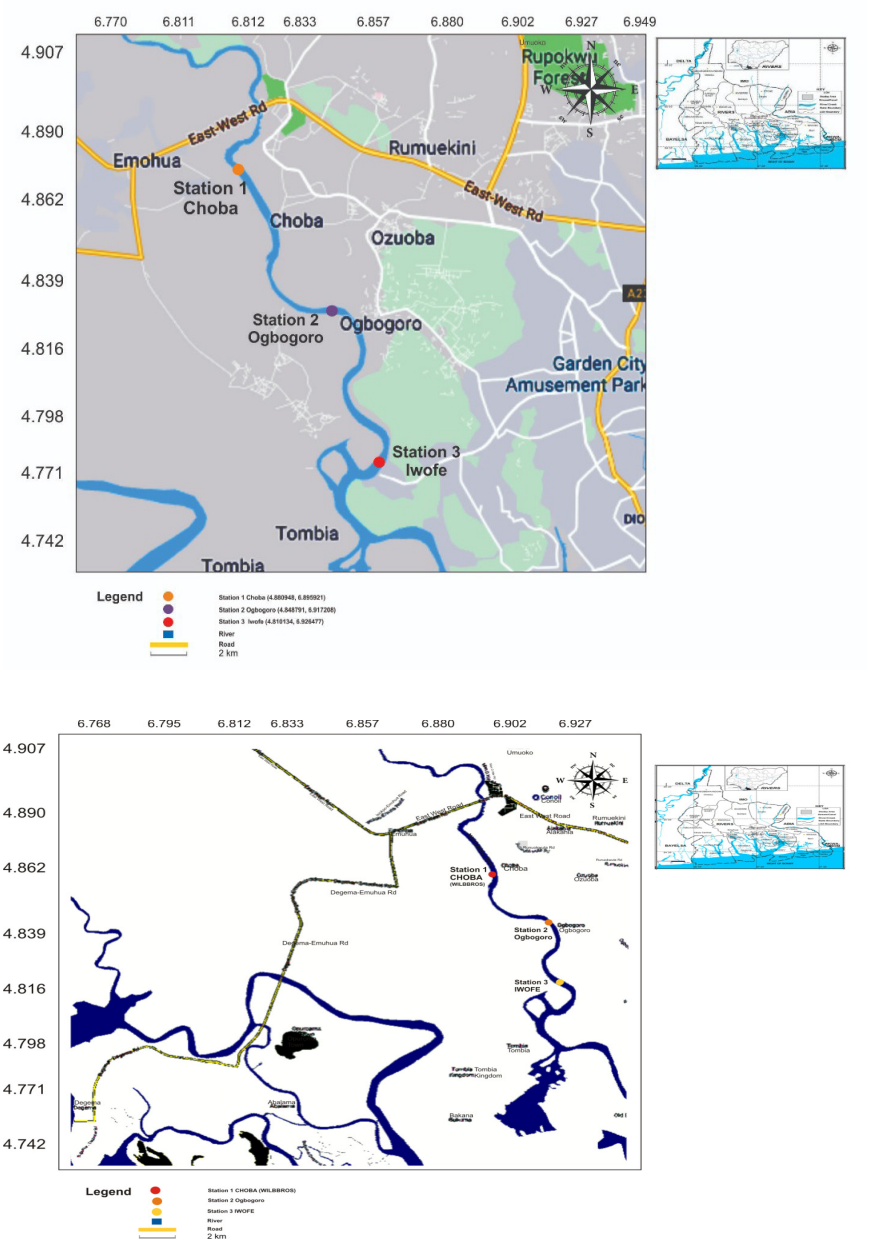

Figure 1. Map of the study area showing the sampling stations

Data collection

Fish samples were collected from three sample stations; Choba, Ogbogoro and wofe landing sites of the New Calabar River. Weekly field survey was carried out from February to July 2018 with the help of local fishermen using various fishing gears: beach net (10 – 15 m length, 2 – 3.5 m height, mesh size 0.5 – 5 cm), fixed gill net (40 – 60 m long, mesh size 15 – 57 mm), cast net (2 – 5 m diameter, mesh size 15 – 20 mm) and local traps (made from raffia palm; diameter 20 mm and 80 mm deep). Fishes were identified according to Adesulu and Sydenham (2007). Fish specimens were measured to the nearest mm using a meter rule and weighed to the nearest 0.1 g with a top loading Sartorius balance (model BP 310S).

Data analysis

A number of ecological indices were used to describe the diversity of mullet species in the New Calabar River:

Relative species abundance (%) = $(n/N) \times 100$

Which refers to the relative representative of a species it was determined by dividing the number of species (n) from each catch by the total number of species (N) from the total catch recorded.

Simpson's index, $d = \sum n(n - 1)\ N(N - 1)$

Where n is the number of individuals of a particular species, d is the diversity index and N is the total number of individuals present in the entire sample.

Simpson's index of diversity = (1 – d)

Simpson's reciprocal index = (1/d)

Shannon-Weiner's index (H') of species diversity, H'= – åPi ln Pi (Shannon and Weaver, 1949)

Where Pi = the proportion of the total number of individuals occurring in species i, n is the number of individuals of each species, and N is the total number of individuals.

Pielou's Index (J) for species evenness J = H'/ln S (Pielou, 1969).

Where H' is the species diversity index and S is the number of species/species richness.

RESULTS

A total of 578 individuals from the family Mugilidae belonging to 3 species, were recovered and identified during the study period as shown in Table 1 below, *P. falcipinus* recorded the most abundant with 47.40% of all the number of species recorded followed by *M. cephalus* (36.85%), while *P. grandisquamis* (15.74%) recorded the least abundant. The dominance order of Mugilid species recorded in terms of percentage weight were *P. grandisquamis* (51.6%) the most dominant, followed by *N. falcipinus* (24.4%) and *M. cephalus* (24.0%) with the least dominant.

The zoonation of the three species as shown in table 2 below revealed that the three species of Mugilid were recorded in station 1, 2 and 3. The diversity indices also revealed that Simpson's index of diversity for stations 1, 2 and 3 were 0.63, 0.62, and 0.59 respectively, while the Simpson's reciprocal index for stations 1, 2 and 3 were 1.60, 1.62 and 1,71 respectively. The Shannon-Weaver diversity index was found the highest (1.03) in station 1 and the lowest (0.96) in station 3. Pielou's evenness index was the highest (0.94) in stations 1 and followed by station 2 (0.93) and station 3 (0.87).

The monthly distribution of Mugilids caught during the study is presented in Figure 2. The results showed that *N. falcipinus, M. cephalus* and *P. grandisquamis* were caught throughout the duration of study. *P. grandisquamis* was the least recorded species. The number of fish species in station 3 was the lowest compared to fish species recovered in station 1 and 2 respectively.

Table 1. Percentage of mullet species by number and weight in the New Calabar River

Species	*n*	%*n*	Wt (g)	%Wt
Neochelon falcipinus	274	47.40	30.73	24.39
Parachelon grandisquamis	91	15.74	65.08	51.64
Mugil cephalus	213	36.85	30.21	23.97
Total	578	100.00	126.02	100.00

Table 2. Zoonation and diversity indices of mullet species in the New Calabar River

Mugilid Species	Stations		
	1	2	3
Neochelon falcipinus	+	+	+
Parachelon grandisquamis	+	+	+
Mugil cephalus	+	+	+
Diversity Index			
Number of individuals	166	283	129
Simpson's index	0.37	0.38	0.41
Simpson's index of diversity	0.63	0.62	0.59
Simpson's reciprocal index	1.60	1.62	1.71
Shannon_H	1.03	1.02	0.96
Pielou's evenness index (J')	0.94	0.93	0.87

-, absent; +, present

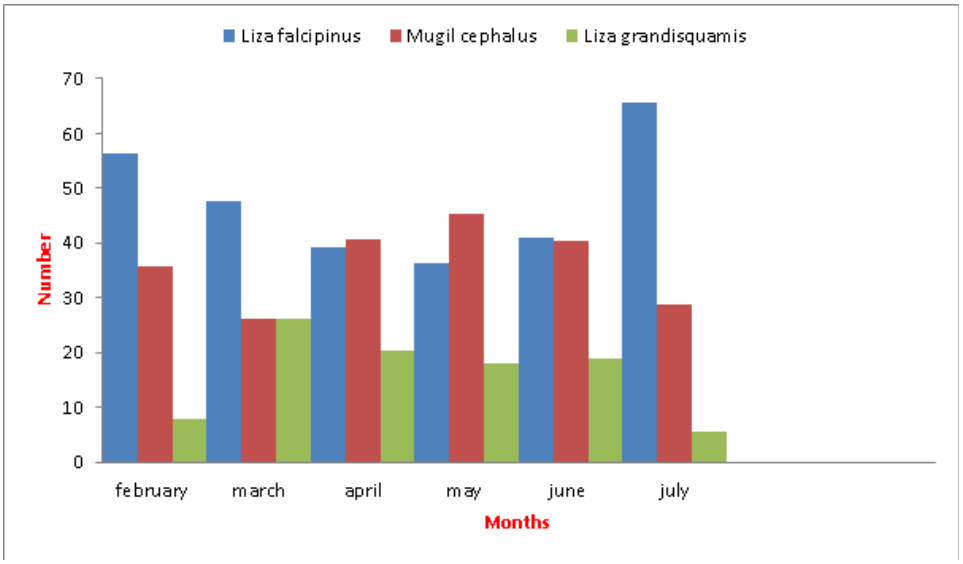

Figure 2. Monthly abundance and distribution of Mugilid species in the New Calabar River

DISCUSSION

The result indicated that three species of Mugilids were found in the New Calabar River. These include; *M. cephalus, L. falcipinus* and *L. grandisquamis*. Mugilid species, are coastal marine fishes, the extraordinary adaptability of the family Mugilidae, has resulted in species that are found mainly in the clear and pristine waters of coral reefs to those that prefer highly turbid estuarine and fresh waters (Crosetti and Blaber, 2016). Examination of three species of mullet within the New Calabar River supports previous findings for individual species, but also provides evidence for the differences present in this family and highlights the need for careful, and potentially individual, management approaches for these species. The fish family Mugilidae is represented in Nigerian freshwater by genus consisting of three species namely *M. cephalus, M. falcipinnis* and *M. hyselopterus* (Adesulu and Sydenham, 2007). Dienye et al., (2018) reportedly identified three Mugilid species listed in the present study from the New Calabar River. Ibim et al., (2016) also identified *M. cephalus* from the New Calabar River. This confirms the presence of the family Mugilidae in the New Calabar

River. *L. grandisquamis, L. falcipinus, M. curema* and *M. bananensis* were identified in waters around Port Harcourt (Allison et al., 2008). Unavailability of some species in this study area may indicate declining trend of fish diversity. King (1996), reported *M. cephalus, L. falcipinus, L. dumerili* and *L. grandisquamis* in a study carried out on the Nigerian coastal waters.

The sampled species recovered in the study area was higher during the wet season (February –April). The marked differences in seasonal abundance could be possible due to habitat preference associated with water levels in the river (Gordon et al., 2003).

In this study, the most abundant specie recorded was *N.falcipinus*,followed by *M.cephalus* with the least abundant species recorded is *P.grandisquamis*.This is in agreement with the findings of Dienye et al., (2018) which also showed the Mugilid species abundance in descending order as *L. falcipinus* > *M. cephalus* > *L. grandisquamis*. Kumolu-Johnson and Ndimele, (2010), also observed that the abundance of *L. falcipinus* was greater than that of *M. cephalus* at the Ologe Lagoon, Lagos. Spatio-temporal variations in the environmental characteristics as well as resource availability are among the main determinants of the species distribution (Grenouillet et al., 2002), species interaction (Zaret and Rand, 1971) and habitat adaptations (Poff and Allan, 1995). The number of species will vary depending on the differences in the sampling methods and sampling effort (gear type, fishing time etc.), as well as fish abundance which is usually affected by migration (Olopade and Rufai, 2014). Therefore, all three species were present in each of the sample months although, the monthly abundance of each Mugilid species varied from month to month.

Diversity indices provide more information than simply the number of species present and they also serve as valuable tools that provide important information about species in a community (Galib et al., 2013). The result of the diversity indices in the study area revealed a Simpson's index value range of 0.37 to 0.41 across the stations. Simpson's index values range from 0 to1, with 1 representing perfect evenness which signifies the presence of all species in equal number. In this study the values recorded were less than 1 which indicates imperfect evenness (Olopade and Rufai, 2014). The Simpson's Index of Diversity was 0.63, 0.62 and 0.59 for station 1, 2 and 3 respectively. According to (Ali et al., 2015), the ecological parameters of a group of species such as species abundance, species dominance, species evenness and Shannon Wiener index are indicators of the health status of any habitat as lowered fish diversity indicates a stressed ecosystem. Higher fish diversity produces more stable fish communities (Albaret and Lae, 2003). Biodiversity tends to decrease with an increase in the value of biodiversity index. This reveals that station 3 was more bio diverse than station 1 and 2. The value of Shannon diversity is usually found to fall between 1.5 and 3.5 and only rarely it surpasses 4.5. The Shannon-Weiner index indicated low species diversity of Mugilids in the study area with the value ranging from 0.96 to 1.03.

CONCLUSION

The present study revealed that New Calabar River played a vital role to provide habitat for the three Mugilid species; *N. falcipinus, M. cephalus* and *P. grandisquamis*. In this study, the most abundant species recorded was *N.falcipinus*,followed by *M.cephalus* while the least abundant species recorded was *P.grandisquamis* All species were well represented across all stations and months and the diversity indices showed that the family Mugilidae was fairly distributed in the study area and it is therefore recommended that further research should be carried out to provide a complete examination of the biology and ecology of the mullets within the New Calabar River.

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